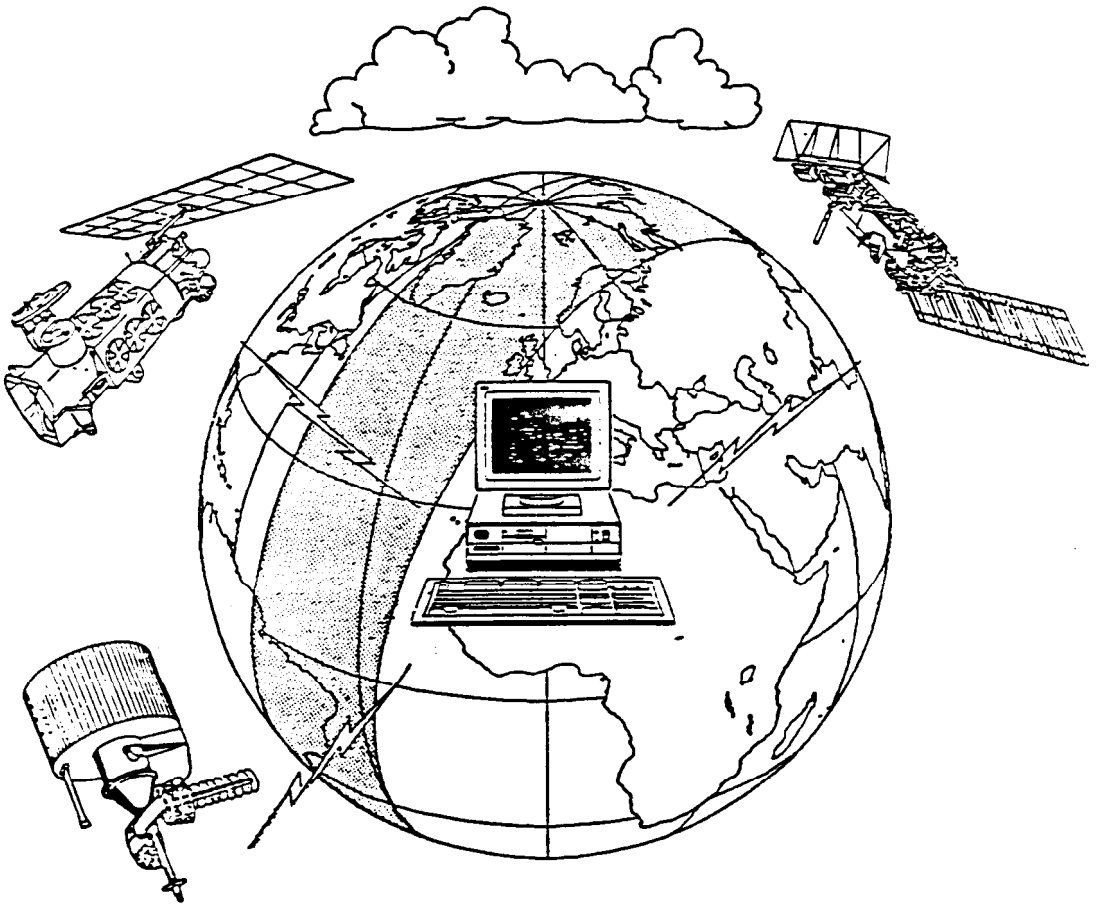
E.4

~70.d5

FUNCTIONAL DESCRIPTION

AFGWC/SYSS



AIR FORCE GLOBAL WEATHER CENTRAL
SATELLITE PROCESSING WORKCENTER **(AFGWC/SYSS)**

FUNCTIONAL DESCRIPTION

AFGWC/SYSS

24 May **1993**

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Satellite Processing workcenter (AFGWC/SYSS)

ACKNOWLEDGEMENTS

We would like to acknowledge and thank the personnel of AFGWC/SY that contributed to the development of this document. In particular, Major John Riess and Captains Will Coats, Mike Farrar, Jay Holzer, Dan Nickerson, Tom Neu, Neal Schroder, MSgt Oliver Stewart, and TSgt Jaqui Martyn-Dow provided valuable assistance in assembling information that was incorporated in this functional description document. Major Laura Kennedy and Captain Leslie Belsma provided comments and project direction. Their efforts and support are very much appreciated.

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APPENDICES

SECTION 1

1.0 General

1.1 Purpose of Functional Description. This Functional Description for the Air Force Global Weather Central Satellite Processing Workcenter (AFGWC/SYSS) is written to provide:

a. A description of the techniques, processes, and data that are used by SYSS to prepare Defense Meteorological Satellite Program (DMSP) and National Oceanic and Atmospheric Administration (NOAA) satellite imagery and sensor data for use by weather analysis and forecasting models.

b. A basis for development of requirements for future upgrades to the AFGWC hardware/software system.

1.2 Project Reference6

The following references apply to this project:

a. Data Reconstruction System, Site III Upgrade Study, The Aerospace Corporation. TOR-0090(5478-31)-1, 31 December 1989

b. SSM/I and SSM/T Sensor Data Flow and Processing, The Aerospace Corporation. TOR-92(2478)-2, 17 February 1992

c. DOD-STD-7935A Automated Information Systems Documentation Standards, 31 October 1988

d. DMSP Environmental Data Flow, Aerospace Corporation Technical Memorandum 88(3478-51)-14

e. AFGWC Pamphlet 105-1, 6 July 1987

f. AFGWC Real-Time Cloud Analysis Model, Technical Note 88/001

g. AFGWC Data Format Handbooks, Vol. 1,2/Version 1, March 90

h. AFGWC Cloud Forecast Models, Technical Note 87/001

i. AFGWC Analysis/Forecast Model System, Technical Note 79/004

j. AFGWC Snow Analysis Model, Technical Note 86/001

1.3 Terms and Abbreviations

AFGWC	- Air Force Global Weather Central
AFTAC	- Air Force Tactical Applications Center
AGRMET	- Agricultural Meteorological
APC	- Antenna Pattern Correction
ASPAM	- Atmospheric Slant Path Analysis Model
AUTODIN	- Automated Digital Information Network
DF	- Data Formatter
DMSP	- Defense Meteorological Satellite Program
DOF	- AFGWC Mission Tailored Product Branch
DOM	- AFGWC Meteorological Products Branch
DOS	- AFGWC Special Operations Branch
DRS	- Data Reconstruction System
EDR	- Environmental Data Record
ETC	- Elapsed Time Counter
FD	- Functional Description
FNOC	- Fleet Numerical Oceanographic Center
GOES	- Geostationary Operational Environmental Satellite
HIRAS	- High Resolution Analysis System
HIPS	- Hardcopy Image Processing Subsystem
IR	- Infrared
LF	- Light Fine
LS	- Light Smooth
NESDIS	- National Environmental Satellite Data Information Service
NGDC	- National Geophysical Data Center
NM	- Nautical Mile
NOAA	- National Oceanic and Atmospheric Administration
NORAD	- North American Aerospace Defense Command
OETS	- Orbital Element Transfer System
OLS	- Operational Linescan System
RMS	- Root Mean Square
RTNEPH	- Real-Time Nephanalysis
SDHS	- Satellite Data Handling System
SDR	- Sensor Data Record
SFC	- (Air Force) Space Forecast Center
SATSCH	- Satellite Scheduling System
SGDB	- Satellite Global Database
SMC	- Space and Missile Systems Center
SOPS	- Satellite Operations Squadron
SSM/I	- Special Sensor Microwave Imager
SSM/T-1	- Special Sensor Microwave Temperature Sounder

SSM/T-2 - Special Sensor Microwave Moisture Sounder

System B - A backup Unisys 1100 (for System A) used to do preprocessing for the Cray

system 5 - A Unisys 1100/91 used for satellite data processing

System 6 - A Unisys 1100/91 used for development and backup

TF - Thermal *Fine*

TS - Thermal Smooth

WIPP - Weather Information Processor Production

SECTION 2

2.0 System Summary

2.1 Background

This project is an initiative supported by the Space and Missile Systems Center (SMC/IMO) that is designed to document the current methods of environmental support provided by the Satellite Processing Workcenter at AFGWC. This phase of the project is intended to document the processing of data received from the DMSP/NOAA weather satellite system from receipt of the data by Site III at AFGWC through input to the analysis/forecasting weather models. The Functional Description for Site III was previously completed by AFGWC personnel. A diagram of Site III is provided at Figure 1.

AFGWC is divided into two divisions. The Operations Division (DO) supports APGWC daily operations, while the Systems Division (SY) supports hardware and software development and' maintenance. SYS is the Software Branch within the Systems Division, while SYSS is the Satellite Processing Workcenter within the Software Branch.

2.2 Objectives

This effort is intended to provide a basis for the proposed rearchitecture of AFGWC systems. An initial objective is to document existing techniques, procedures, processes, and data-flows that support various AFGWC customers. To support this objective, this document was written in the form of a Functional Description (FD) (Reference c). The Functional Description will then provide a basis for the development of requirements for an upgrade of the facility hardware/software. Also, the FD will aid in the development of a Request For Proposal (RFP) and will provide information to contractors who bid on the proposed AFGWC upgrade contract. Computer-Aided Software Engineering (CASE) diagrams for SYSS functions are included in Appendix A.

2.3 Existing Methods and Procedures

DMSP satellites are designed to acquire and store environmental data from an altitude of 450 nautical miles (NM) in a polar sun-synchronous orbit. They can read out the stored data to a ground station or transmit the data in real time to a

tactical van or shipboard terminal. DMSP has four recorder8 on board to store imagery/mission sensor data and four transmitters to downlink data. The recorders have the capacity of storing 40 minutes of fine data (visual or infrared (IR) at 0.3 NM) or 400 minutes of smooth data (visual or IR at 1.5 NM). The satellite is capable of reading out and downlinking three recorders' simultaneously. Typically, one or two recorders are read out simultaneously to a ground station. The DMSP satellites downlink imagery and telemetry to one of four ground stations normally at least once per revolution. The ground stations are located at Fairchild AFB, Washington, and sites in New Hampshire, Thuls (Greenland), and Hawaii.

From the ground station the downlink signal is retransmitted to AFGWC at Offutt AFB, Nebraska and the Navy's Fleet Numerical Oceanographic Center (FNOC) in Monterey, California via communication satellites. FNOC processes and uses smooth visual and IR imagery and Special Sensor Microwave Imager (SSM/I) sensor data. Imagery from NOAA weather satellites is received at Offutt AFB from Wallops Island, Virginia and Gilmore Creek, Alaska via a communications satellite. Since AFGWC processes many satellites,. there is a prioritization scheme which may cause longer processing times for NOAA data. Also, Geostationary Operational Environmental Satellite (GOES) imagery is received at Offutt AFB from the Wallops Island ground station via a transponder on the GOES satellite.

The DMSP downlink signal is sent from the receive antenna to the Site III Data Reconstruction System (DRS) ingest facility via a fiber optic line. The fiber optic receiver simultaneously sends the entire data stream to the 6th Satellite Operations Squadron (6th SOPS). Next a demultiplexer removes the voice data, telemetry, and site status data before sending the data stream to a level converter. Refer to Figure 1 for a diagram of the overall data flow in Site III.

A KG44 decryption device forwards the data to the deinterleaver. The deinterleaver separates the downlink data into Operational Linescan System (OLS), visible, infrared, and mission sensor data streams.

The downlink data then enters the Switching and Patching Subsystem and is routed according to its processing requirements. The Switching and Patching Subsystem routes DMSP data to the Data

SATELLITE EPHEMERIS (GEOLOCATION) SYSTEM

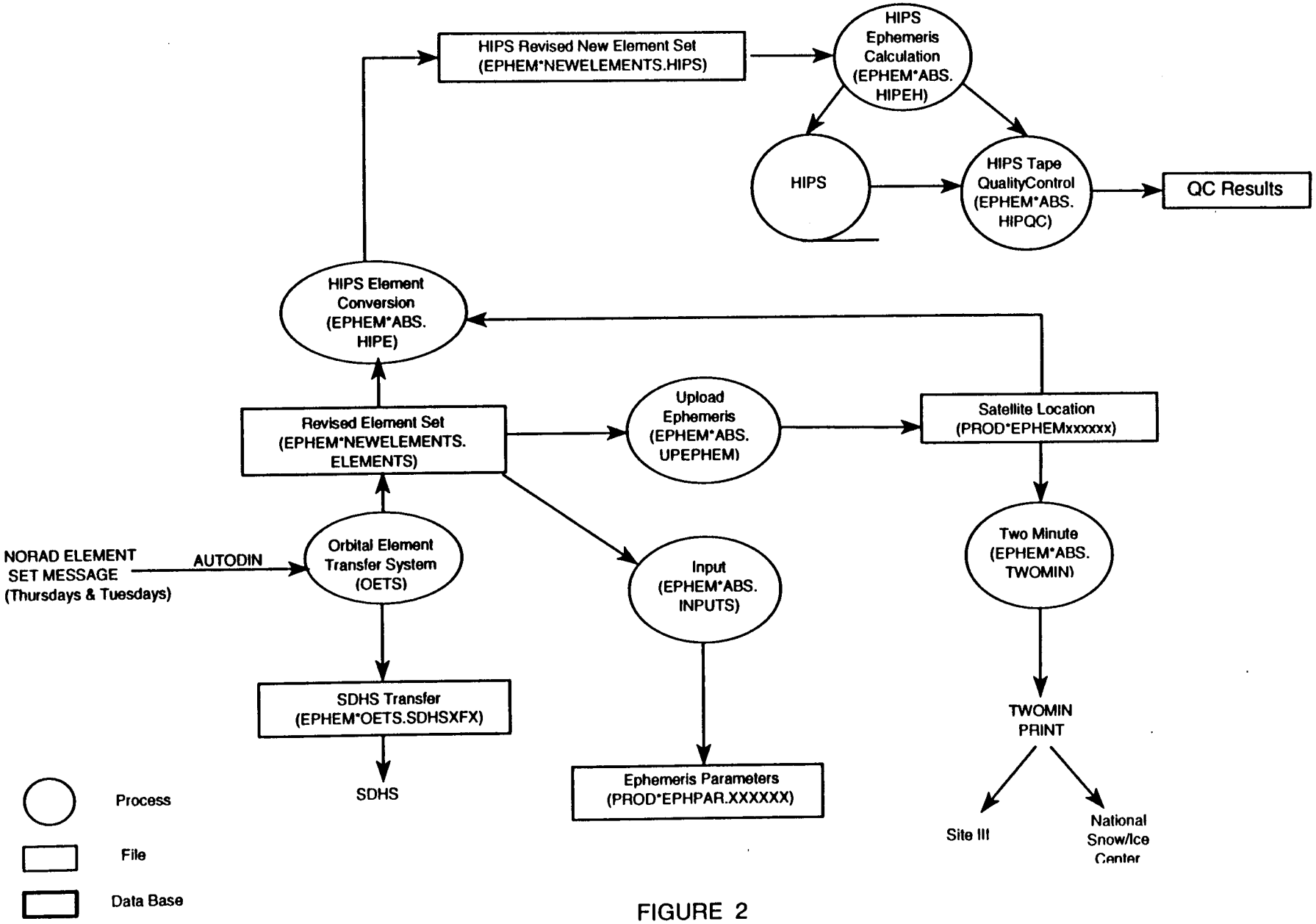


FIGURE 2

Formatter (DF), archives DMSP data to magnetic tape, and sends selected DMSP data to the Hardcopy Image Processing Subsystem (HIPS). The HIPS processor sends orbit time information to the operator's console. DMSP data is also routed through a decommutator to the Satellite Data Handling System (SDHS). The decommutator does some image calibration and frame synchronization functions. The data signal for the Data Archival Exabyte storage system is patched around the deinterleaver in Site III because the archival system contains its own deinterleaving boards. The data signal is processed in an unaltered form for storage. The Exabyte cartridges are sent to the National Snow and Ice Center in Boulder, Colorado for permanent storage.

The Data Formatter buffers and reformats the mission sensor data into one-second packets and forwards the data to a Unisys computer (System 5) for processing. At the same time, OLS data is smoothed to 3 NM and forwarded to System 5 for processing. System 5 mission sensor processing separates the data into Prepfiles by sensor type and then generates Sensor Data Records (SDRs). Also on System 5, the SYNAPSE OLS processing software prepares the OLS data for inclusion into the Satellite Global Database (SGDB). The SGDB is the central point of access for visual and infrared satellite data for AFGWC's models (Real Time Nephanalysis (RTNEPH), Atmospheric Slant Path Analysis Model (ASPAM), High Resolution Analysis (HIRAS), etc.). The SDHS system also has access to the SGDB for displaying data if desired. The SDHS can also display any DMSP visual or infrared data that is received by Site III.

NOAA data is also incorporated into the RTNEPH. NOAA and GOES are received via their own antennas and fiber optic receive equipment. The NOM signal is input to Site III at the Switching and Patching Subsystem function and is routed through a decommutator to the SDHS. It is also routed to the Data Formatter and then to System 5 for RTNEPH processing. The GOES satellite signal is also routed through the Switching and Patching Subsystem to a separate decommutator before being stored on the SDHS. GOES data is only used on the SDHS for display and hardcopy purposes.

2.3.1 Scheduling Processes

The scheduling process identifies for Site III which primary and mission sensor data is to be expected and when it should be received by AFGWC. The process includes data receipt and processing schedule information for the DMSP vehicles (currently F8 - mission sensor data only, and F10 and F11 - primary sources of data) and NOM satellite primary sensor data (N11 and N12).

The scheduling process identifies requirements for the data, data processing, and associated priorities. AFGWC processing software verifies data receipt based upon scheduling information. User requirements at AFGWC are identified by AFGWC/Special Support Branch (DOS) & Mission Tailored Product Branch (DOF) (sprint, or mission essential requirements), AFGWC/Meteorological Products Branch (DOM) (for the SGDB and forecast generation), and Site III (ingest and dissemination).

Scheduling products are used to build the customer Prepfiles (files that contain reformatted mission sensor data, one for each sensor) and the SGDB. Information on the elapsed time counter (ETC), or fiducial are also included as part of the scheduling process. This provides the position in time that the OLS is scheduled to turn on or off. The ETC, given in seconds, is reset daily at 0000Z

The AFGWC scheduling process that has existed for many years, known as the "Ephemeris Data Scheduling" process (EPHEMDAT), is currently being replaced in order to streamline, update, and automate the process, and to reduce the manual input of data needed to develop the AFGWC schedule. The new process will also eliminate the need for seven-day and three-day schedule update processes, replacing these with one process that will build a two-week schedule, once each week.

The revised process, the Satellite Scheduling System (SATSCH), is being written at this time and is expected to be fully operational in November 1993. SATSCH will be a much more flexible scheduling system that will be capable of handling data from up to eight satellites and will permit the scheduling of up to seven sensors per satellite.

2.3.1.1 Satellite Ephemeris (Geolocation) System

The process of building the new ephemeris files starts each Thursday with the receipt of the North American Aerospace Defense Command (NORAD) Element Set message from NORAD via the Automated Digital Information Network (AUTODIN). The Element Set Message contains propagated two-card Keplerian element sets for ten days into the future. An Element Set message is received twice weekly, on Tuesday and on Thursday. The Tuesday message is an update of the previous Thursday message, a propagated element set valid for six days into the future.

Early each Tuesday, the two-card NORAD Element Set AUTODIN message is received by the Weather Information Processor Production (WIPP) which verifies that the data is complete. If errors are identified, a re-transmission of the element set is requested from NORAD.

The new ephemeris system name was unknown at the time that this functional description was written. The following files were named with a convention of EPHEM*.___ This replaced the previous SIGSS*.___

Unlike the "old" Ephemeris Data Scheduling process, the Orbital Element Transfer System (OETS) does not require the manual input of the NORAD Element Set message into the scheduling process. Upon receipt on Tuesday, this data is automatically sent to the SDHS by OETS via HYPERchannel in the form of a New Element Set file (EPHEM*OETS). The New Element Set file is archived on System B and System 6 in the event that another build is necessary.

On Thursday, another Element Set message is received by WIPP. This message provides updated ephemeris data for the next ten days and is actually used in building the AFGWC schedule. When the Element Set message is received, it replaces any existing file on the system. OETS takes the AUTODIN message from WIPP and sends it to System 5, quality controls it, formats it, and ships it to SDHS. Thus, the SDHS transfer file that was generated on Tuesday for SDHS is updated and a Revised Element Set file (EPHEM*OETS) is created and transferred. The Revised Element Set file is also sent to Systems B and 6 for archival in the event another build is necessary.

The "Upload Ephemeris" process reads data from the Revised Element Set file in order to propagate the satellite "backward" or "forward" to the proper orbital start point so that precise satellite position information can be derived. From this point, the satellite is propagated minute by minute until the stop revolution is found. This information is sent to the Satellite Location files (PROD*EPHEMxxxxxx, where "xxxxxx" is the satellite identification number) for use by other processes. The Satellite Location file provides minute by minute satellite location information for use in processing primary and mission sensor data for each DMSP satellite (one file for each satellite), including ascending and descending nodal data on the element set used.

Before the Satellite Location file is used operationally, a background quality control check is performed to compare the old ephemeris data with the new. The new data must be within established tolerances before it is accepted and processed.

The Revised Element Set file, together with information from the Satellite Location file and date/time information, is used by the "HIPS Element Conversion" process (EPHEM*ABS.HIPELT) to generate the HIPS Revised New Element Set file (EPHEM*NEWELEMENTS.HIPS). The "HIPS Ephemeris Calculation" process (EPHEM*ABS.HIPEPH) then uses this file to make a HIPS tape. The information is also sent to the "HIPS Tape Quality Control" process (EPHEM*ABS.HIPQC) which then performs a verification check against the HIPS tape to ensure data accuracy.

Revised Element Set file data is forwarded to the "Input" process (EPHEM*ABS.INPUTS) which uses the information to develop the Ephemeris Parameters file (PROD*EPHPAR.xxxxxx). This file breaks out the element set data into separate files by satellite. Separation of the data by satellite is required by AFGWC/DOS. This information is sent to Systems 3, 5 and 6.

The "Two-Minute" process (EPHEM*ABS.TWOMIN) receives data from the Satellite Location file and generates satellite geolocation information at two-minute intervals. The TWOMIN Print report is produced from this data and is sent to Site III and to the National Snow and Ice Center in Boulder, Colorado. Site III uses this report to verify the gridding of HIPS images. Refer to Figure 2 for a diagram of the satellite ephemeris (geolocation) system.

SATELLITE EPHEMERIS (GEOLOCATION) SYSTEM

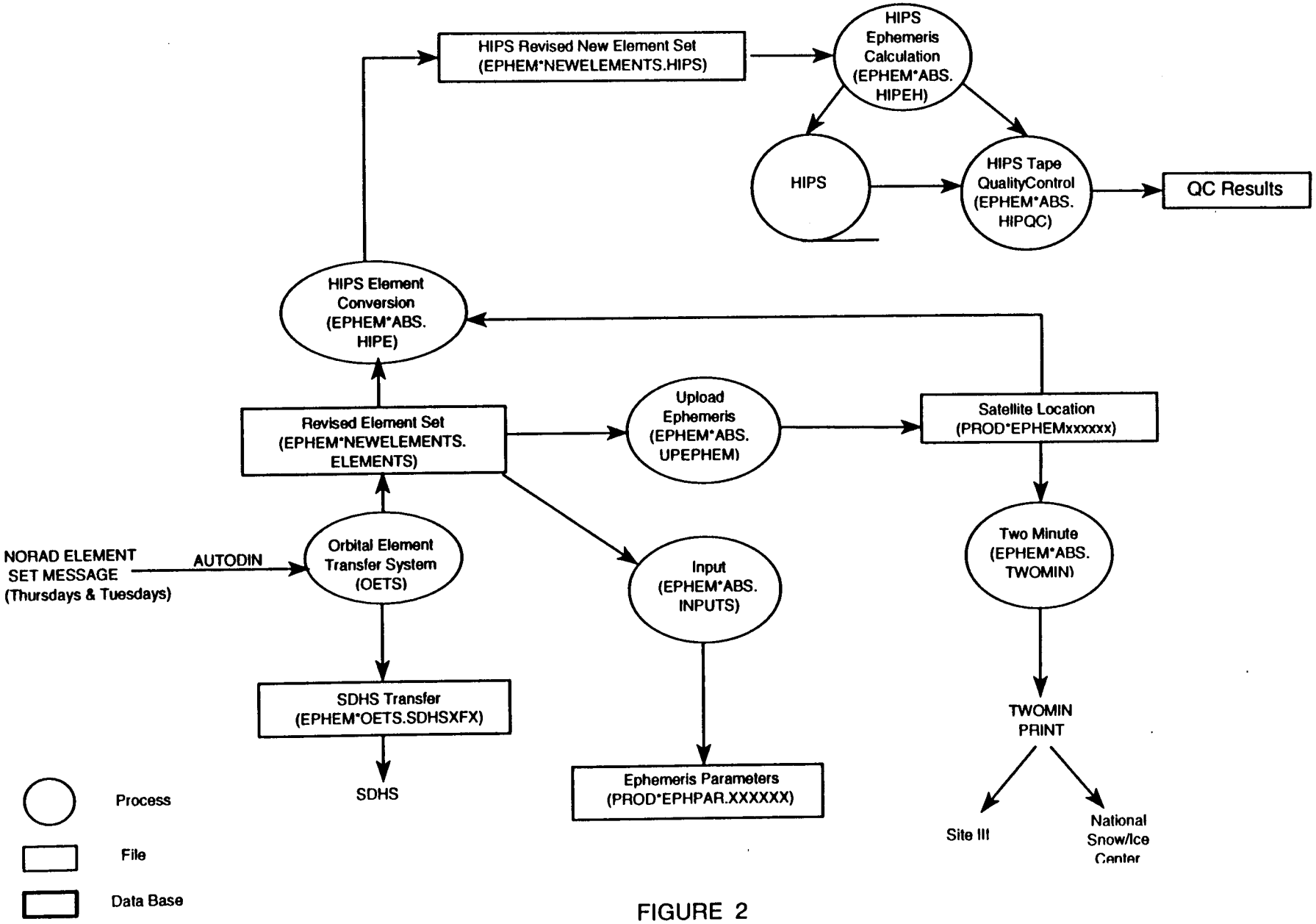


FIGURE 2

A: Organization Responsible: SYSS
B: Equipment: Unisys 1100/91 (System 5)
c: Input: NORAD Element Set Message
Output: HIPS Tape
PROD*EPHEMxxxxxx
PROD*EPHPAR.xxxxxx
Satellite Propagation data to SDHS
TWOMIN Print

2.3.1.2 Predictive Scheduling Files

The process to build the DMSP Predictive Scheduling file (SATSCH*DMSP) involves two tapes. The FNOC tape, which is for readout site prediction, is built by the 6th SOPS, and provides readout site prediction, identifies which readout revolution will be played back to the ground station, and the time and location of each satellite revolution. This tape is input to the "Read DMSP Data" process (SATSCH*ABS.DMSP) which reads the data, does a quality control check and converts the data into the proper format. The data is then written to the DMSP Predictive Scheduling file.

The other tape, the AFGWC tape (also created by the 6th SOPS), contains the Master Command Load List (KCMLL) which identifies the on and off latitude and fiducials for each satellite revolution. It is provided in 24 increments, for seven days, and is also processed by the "Read *DMSP* Data" process to place the KCMLL data into the DMSP Predictive Scheduling file.

The weekly NOM Interrogation Schedule provides projected interrogation times for NOM satellite data. The schedule is received via an electronic bulletin board in Site III and then is manually inserted and transferred through the M-link, which is the communication link from AFGWC personal computers to the mainframe, System 5. It is the pseudo-equivalent of the FNOC tape for NOM satellites, and includes data such as satellite identification, revolution numbers, site readout, time of readout and orbit information. It is formatted into the NOM Predictive Scheduling file (SATSCH*NOAA) by the "Read NOM Data" process (SATSCH*ABS.RDNOAA).

AFGWC also receives a daily NOAA command listing which contains the date and time, and start arid stop of the NOM command load list. It can be printed and used, if desired, by Site III personnel to determine if all of the expected NOM data was in fact received on that particular day, as projected by the Team Chief checklist.

All files and interim processes created during development of the scheduling files are backed up to tape. This is done to permit the system to be restored in the event of a system crash. See *Figure* 3 for an overview data flow diagram for the satellite scheduling system.

A: Organization Responsible: SYSS
B: Equipment: Unisys 1100/91 (System 5)
C: Input: *FNOC Tape*
AFGWC Tape
NOAA Interrogation Schedule
Output: DMSP Predictive Scheduling File
NOM Predictive Scheduling File

2.3.1.3 Processing Requirements File

The procedure to build the Processing Requirements file (SATSCH*PROCREQ) starts with the standing requirements contained in the Processing Requirements Database. These requirements are input to the "Update Requirements" process (SATSCH*ABS.RQMNTS) and define such things as user and AFGWC/DOS area coverage requirements, sprint *versus non-sprint, priority, and* extent of quarter-orbit coverage necessary to satisfy the requirement.

The process defines for SYNAPSE, the Satellite Data Processing function, what OLS data is to be put into the SGDB and where (by quarter-orbit), and if the RTNEPH model is to be run. The process only identifies OLS data; no mission sensor requirements *are* specifically identified.

The Requirements process is run only when a user requirement changes. In order to incorporate those changes, the process is run with the new requirements included and a new Processing Requirements file is generated. The new information is included in the scheduling process only after the "Satellite Schedule" process is rerun.

Satellite Scheduling System

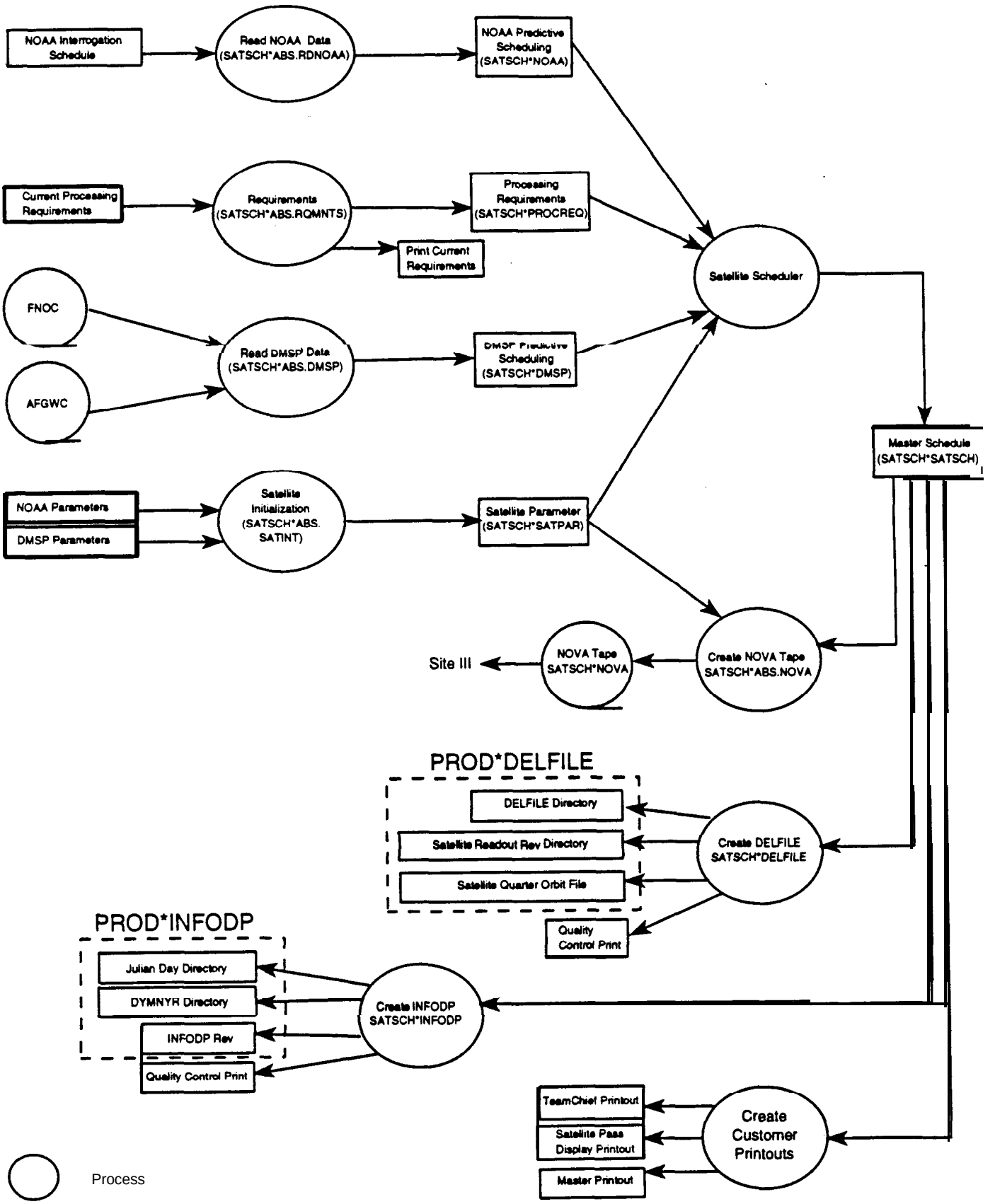


FIGURE 3

A: Organization Responsible: SYSS
B: Equipment: Unisys 1100/91 (System 5)
C: Input: Processing Requirements Database
output: SATSCH*PROCREQ

2.3.1.4 Satellite Parameters Pile

The Satellite Parameters Database contains information on the various satellites that will have data ingested and processed by APGWC. This includes specific satellite parameters, orbit inclination angles, and DF Header Card information for each satellite.

The "Satellite Initialization" process (SATSCH*ABS.SATINT) reads the data elements in the Satellite Parameters Database and converts them into the proper ASCII format for the Satellite Parameter file (SATSCH*SATPAR). These parameters are updated rarely, occurring only when such things as a parameter for an existing satellite changes or when a new satellite is launched.

Output from the Satellite Parameter file is also provided to the "NOVA" process (SATSCH*ABS.NOVA) which builds the NOVA file (SATSCH*NOVA). Data element information on the satellites, such as quarter-orbit information for each satellite, is obtained from the Satellite Parameter file. In addition, revolution number and satellite identification are obtained from the Master Schedule file (SATSCH*SATSCH) (see paragraph 2.3.1.5 below). The resulting NOVA file contains the DF Header Card and scheduling information. The file is sorted by satellite and then in a time sequence by satellite format. The NOVA file is copied to the NOVA Tape and is provided to Site III where it is loaded onto the NOVA machine.

A: Organization Responsible: SYSS
B: Equipment: Unisys 1100191 (System 5)
C: Input: Satellite Parameters Database
SATSCH*MASTER
Output: NOVA Tape
SATSCH*SATPAR

2.3.1.5 Master Schedule

The Master Schedule file provides a schedule of satellite command and readout activity for 14 days. The schedule provides

ephemeris data and all scheduling products for AFGWC.

The "Satellite Scheduler" process builds the Master Schedule file and receives inputs from the following files: DMSP Predictive Scheduling, NOAA Predictive Scheduling, Processing Requirements, and Satellite Parameter. The process is run every Thursday to add a new week to the file. The result is a 14 day window that is constantly rolling forward in order to maintain current and accurate scheduling information for the seven day period beginning every Monday.

Three standard printouts or reports are generated by the "Print" process (SATSCH*TCHIEF, SGDB, & MASTER)). The Satellite Pass Display (SGDB) printout provides a pass by pass breakout of the data available. The Team Chief Checklist printout is a report provided to the Site III team chief and provides information on the sequence of data arrival by time instead of by satellite. The Master printout gives SYSS a troubleshooting and quality control tool.

The "Create INFODP & Create DELFILE" processes (SATSCH*INFODP and SATSCH*DELFILE), generate two files. The first, the Mission Sensor Scheduling file (PROD*INFODP), is used by the "Mission Sensor Data Sort" process (SSPSRT) in the Mission Sensor Preprocessing function to quality control the readout of revolution data. The second, the Quarter-Orbit Control file (PROD*DELFILE), is used by the "Satellite Processing Controller/Manager" process (SPNCON) within SYNAPSE and in SSM/I processing. These processes will be deleted when SSPSRT and SYNAPSE software sections are modified to use the SATSCH*MASTER file.

A: Organization Responsible: SYSS
B: Equipment: Unisys 1100/91 (System 5)
C: Input: SATSCH*DMSP
SATSCH*NOAA
SATSCH'PROCREQ
SATSCH*SATPAR
Output: NOVA Tape
PROD*DELFILE
PROD*INFODP
Satellite Pass Display Printout (SGDB)
SATSCH*MASTER
Team Chief Checklist

2.3.1.6 NOAA Data Receipt and Processing

NOM visible and infrared data is received through the Site III DF and is processed in a similar manner as the DMSP data. Only primary sensor data from the NOM satellite is received. The data is processed into the SGDB and then forwarded to the SDHS three times each day. Data from each quarter orbit is also sent to the SDHS. NOAA data can be used to replace DMSP OLS (visual and infrared) data if *required.*

2.3.2 Primary Sensor Processing

The DMSP satellite's imaging sensor, the OLS, is the primary data acquisition system used by AFGWC. The OLS provides high resolution 0.3 NM imagery in the infrared (thermal fine (TF)) and visible (light fine (LF)) regions of the electromagnetic *spectrum.* Electronic smoothing converts the TF and *LF data to 1.5 NM* medium resolution imagery in the infrared thermal smooth (TS) and visible light smooth (LS) spectrum, allowing *recovery of.* stored data on a global basis. Another visible channel provides only LS imagery under half moon or brighter night illumination. The OLS includes and controls four digital tape recorders, each with a storage capacity of 1.67 x 10' bits.

Data can be transmitted in real-time to Mark IV vans, and is also stored on-board for playback and transmission to the readout sites when the satellite is over the readout site. The system's data management unit has a capability to acquire, process, record, and output data from up to 12 sensors. The OLS provides complete global meteorological imagery every day. While AFGWC receives all data from all of the DMSP sensor suite, the Navy *Fleet* Numerical Oceanographic Center processes only OLS and SSM/I data.

The following atmospheric data products can be derived from the OLS: cloud amount, type, layers, and togs; albedo (reflection off of the earth's surface); cloud-free line-of-sight (CFLOS); precipitation; severe weather; icing; and target scene polarity (ie., white on black). In addition, ionospheric data products that can be derived from OLS data include: aurora1 emissions; aurora1 boundaries; and ionospheric conductivity.

Refer to Figure 4 for a diagram of primary mission sensor processing.

2.3.2.1 SYNAPSE Process

After the data is split in the DF in Site III into primary and mission sensor data streams, the OLS data is sent to the SYNAPSE function. SYNAPSE is the major software system that controls, directs and manages the receipt and processing of DMSP Block 5D data, including rectification of that data into the SGDB. Within SYNAPSE, the "Realtime Data Take and Monitor" process (NERVE) is continuously monitoring the DF channel for other than "zero" bits. When a "one" bit is encountered, the "Realtime Data Take and Monitor" process recognizes that data will be received in 10 to 20 seconds. Should the connection between Site III and SYNAPSE be down, a DF Backup Tape can be used to load the data into the SYNAPSE function. The NERVE process builds two files, First Raw Data file (PROD*FIRST) and the Second Raw Data file (PROD*SECOND). These files are filled with the raw satellite data, nine buffers at a time, alternating between files.

The "Satellite Processing Controller/Manager" process compares information from the Quarter-Orbit Control file (which describes the data to be expected) with the header data that' comes in through the "Realtime Data Take and Monitor" process. The comparison is done in order to determine if the data that was received was what was actually expected. If the data is as expected, a signal is sent to the "Data Rectification" process (CARTO) to begin ingesting data into the SGDB. The "Data Rectification" process also obtains data from the Satellite Location files in order to perform its function.

The "Data Rectification" process creates three georeferenced databases, one each for both Doles on a Polar Stereographic projection, and one for the rest of the world on a Mercator projection. The "Data Rectification" process pulls the data from the First Raw Data File and Second Raw Data file for incorporation into the SGDB, always processing the file that is not being accessed by the "Realtime Data Take and Monitor" process. The process then continues back and forth between the "First" and "Second" files until the data flow is complete and all data is transferred to the SGDB. The process takes about four minutes to go from Site III to the SDHS for a full satellite

PRIMARY SENSOR PROCESSING

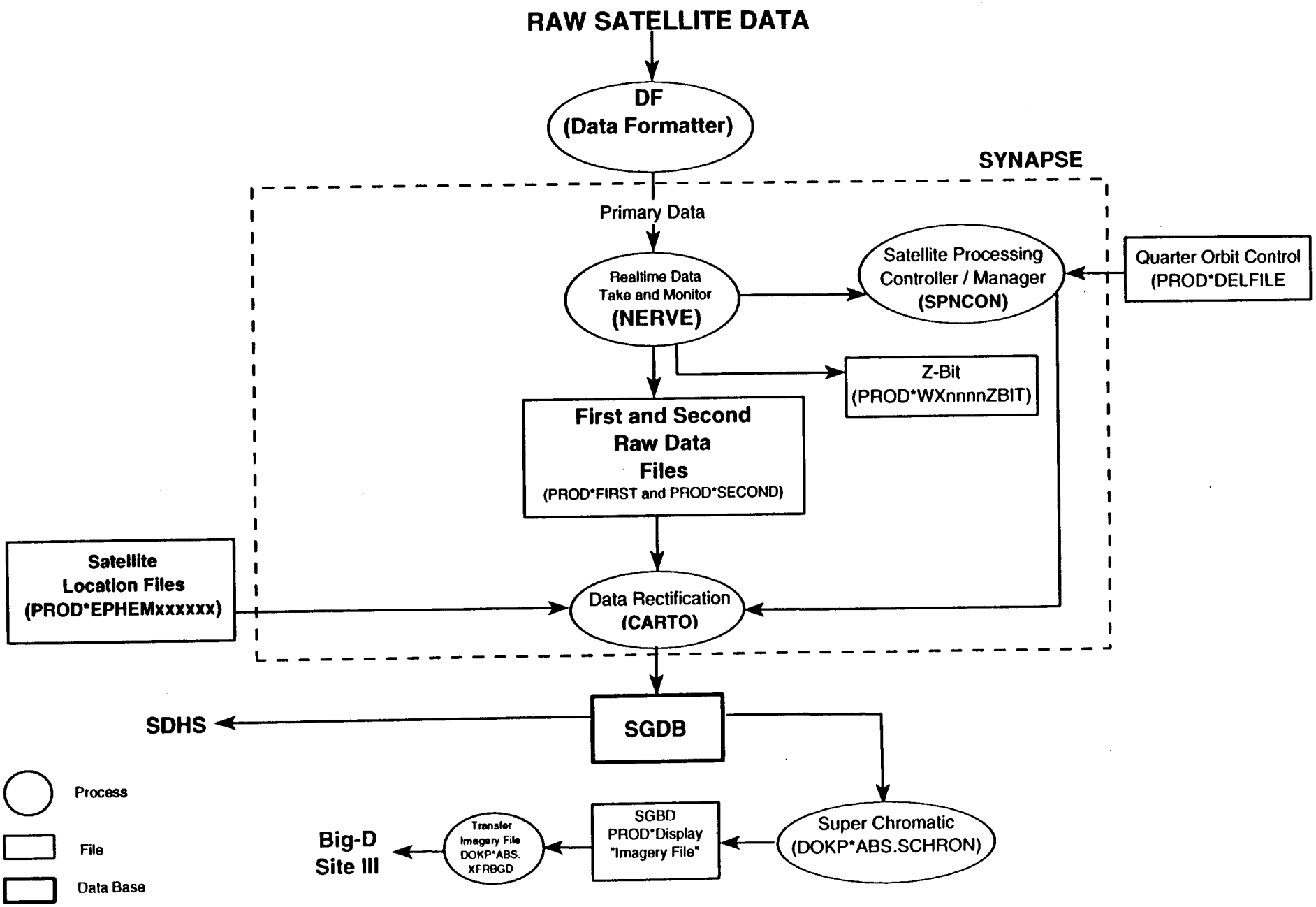


FIGURE 4

readout.

In addition, the "Realtime Data Take and Monitor" process updates the Z-Bit files (PROD● WEnnnnZBIT, where ❑ nnnnm is a DMSP vehicle identification number) that contains the on-board ephemeris data. The ephemeris data is Dulled from each scan line of the imagery. Processing of the SSM/I data uses this file to earth locate the SSM/I imagery. All other mission sensors use the Satellite Location file generated during the schedule build process.

A: Organization Responsible: SYSS
B: Equipment: Unisys 1100/91 (System 5)
C: Input: Primary Sensor Data from the Data *Formatter (or* the Data Formatter back-up tape)
PROD*DELFILE
PROD*EPHEMbcccccc
Output: SGDB
PROD*WXnnnnZBIT

2.3.2.2 Display Process

An additional use of the SGDB is in the production of visual or IR pictures produced by the BIG-D display machine. Data from the SGDB is extracted and put into files by the "Super Chromatic" process (DOKP*ABS.SCHRON) and then transferred back to Site III, via the HYPERchannel, by the "Transfer BIG-D" process (DOKP*ABS.XFRBGD). The "Super Chromatic" process extracts visual or IR data for specific areas of the world at set times each day. The actual pictures are then prepared by the BIG-D for selected customers both within and external to AFGWC. For example, Site III uses the display for quality control purposes. Refer to Figure 5 for a diagram of the Display process.

The Display Requirements file (DOKP*RUN.DSPINT) is an add element (a string of data that is read by a program) containing the static requirements for display of SGDB imagery. Whenever the static requirements change, this file is modified so that it contains the new data and the "Display Initialization@' process (DOKP*ABS.DSPINT) is executed to read the add element data into the Display Control file (PROD*DISPCNTRFILE) in ASCII format. The Display Control file is a word oriented single sector file of static display requests.

DISPLAY PROCESS

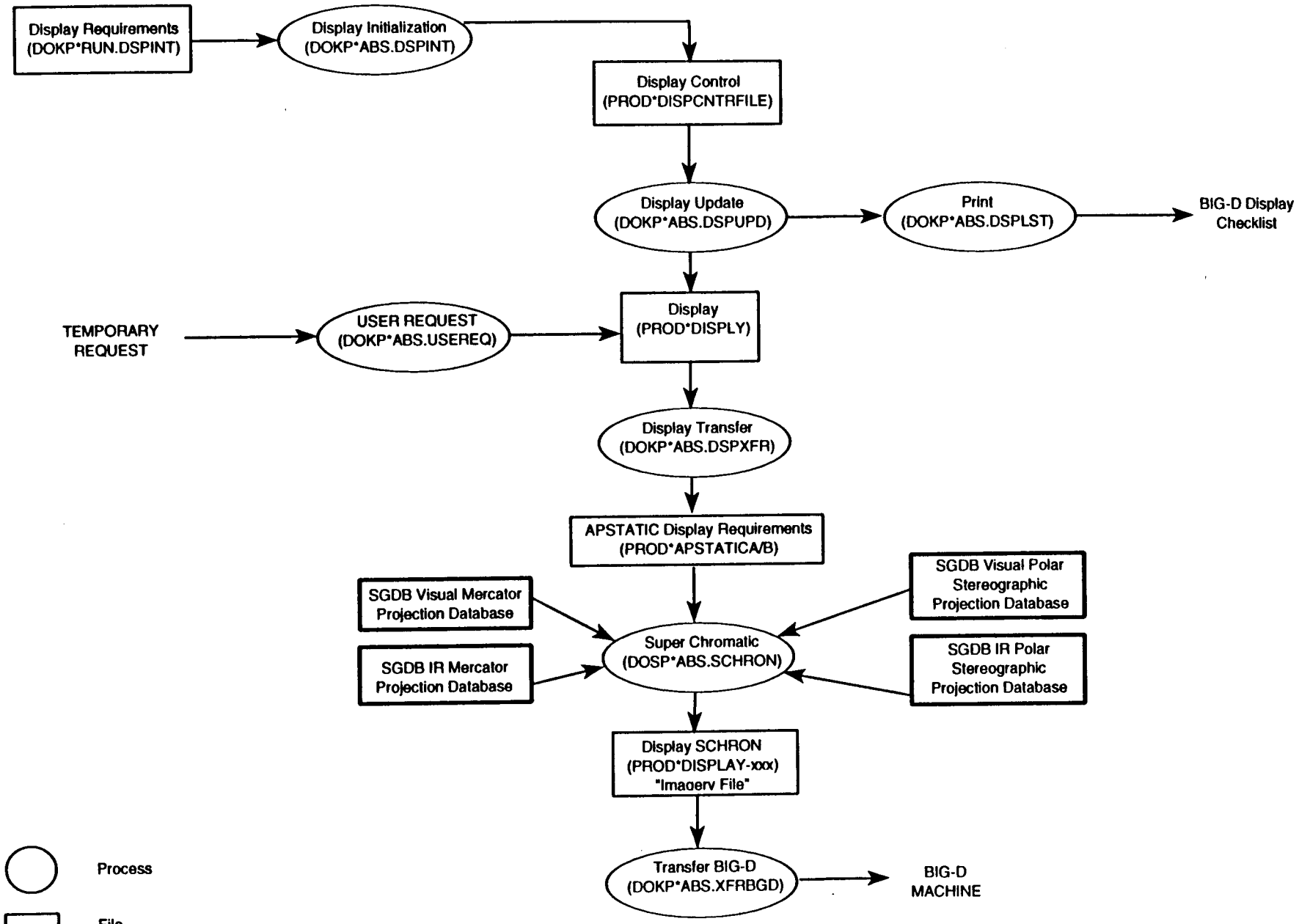


FIGURE 5

The "Display Update" process (DOKP*ABS.DSPUPD) generates the Display file (PROD*DISPLY) which is a 14-day schedule of BIG-D display requirements. This process is run routinely on every Monday to update the contents of the DOKP*DISPLY file. This allows for changes in display requirements as well, because it can be run at any time. It also provides an editing capability that permits "off cycle*'changes to be made to the Display file if necessary. Temporary, or one-time, requests for displays are routed through the "User Request" process (DOKP*ABS.USEREQ). These requests can be for a one-time display or multiple display requests up to two weeks in duration. The process is interactive in that the user is prompted for the appropriate information. The process forwards the temporary request to the Display file.

The BIG-D Display Checklist printout is generated from the Display file (PROD*DISPLY) by the "Update" process (DOKP*ABS.DSPUPD). This printout contains information on the sequence of events for the display of imagery on BIG-D. The printout provides a two week-long, time sequenced schedule that permits Site III personnel to track imagery display processing.

The "Display Transfer" process (DOKP*ABS.DSPXFR) takes requirements from the Display file and generates the APSTATIC Display Requirements files (PROD*APSTATICA/B). These files, in field data format (a six-bit character code which is the standard internal character set used by the Unisys 1100 EXEC operating system), define the display requirements for the next 24 to 48-hour period and provide the instructions for the "Super Chromatic" process. This is a temporary measure to be used only until the "Super Chromatic" process is modified to read directly from the Display file. The APSTATIC Display Requirements files are regenerated each day into "A" and "B" files which contain requirements for the current as well as the following day.

Information from the APSTATIC Display Requirements files are provided to the "Super Chromatic" process which defines the visual pictures to be produced on the BIG-D in Site III. This process, which continuously runs on System 5, copies data from the SGDB to prepare files of specific areas of the world at set times each day. Data is obtained from the SGDB visual and IR Polar Stereographic projection databases, and from the visual and IR Mercator projection databases.

The "Super Chromatic" process formats the image data

correctly for the BIG-D machine, generating the Display SCHRON files (PROD*DISPLAY-xxx, where "xxx" is the assigned display number from the APSTATIC Display Requirements files). This file is then transferred by the "Transfer BIG-D" process to Site III and is then used by the BIG-D machine to generate the hardcopy displays of SGDB information in response to requirements from selected customers in AFGWC.

A: Organization Responsible: SYSS
B: Equipment: Unisys 1100/91 (System 5)
C: Input: SGDB IR Mercator Projection Data
SGDB IR Polar Stereographic Projection Data
SGDB Visual Mercator Projection Data
SGDB Visual Polar Stereographic Projection Data
DOKP*RUN.DSPXXX
Temporary Requests
Output: PROD*DISPLAY-xxx
BIG-D Display Checklist

2.3.3 Mission Sensor Processing

The Mission Sensor Preprocessing function is responsible for ingesting, sorting, and storing data for all DMSP Mission Sensors. Sensor data is stored into preparation files (Prepfiles), which are files that contain reformatted mission sensor data. One Prepfile exists for each mission sensor, except for the SSM/I data, which has a separate file for each satellite. No NOAA mission sensor data is processed at this time. A list of DMSP mission sensors and their functions is provided at Appendix B. Specific functions performed by the Mission Sensors Workcenter are described in the following paragraphs.

2.3.3.1 Mission Sensor Preprocessing Function

The "Mission Sensor Data Ingest* process (SSPRCV) receives raw mission sensor satellite data from the Data Formatter in Site III and stores the data on disk. After the ingest is complete, the data are sorted by sensor type and stored in individual files ready for use by application programs.

In addition, mission sensor programs can supply data to outside customers via tapes, AUTODIN transmission, and landline or satellite data link transfers. The mission sensor data files are also used to monitor both meteorological and space

environment characteristics. Mission sensor personnel also work closely with contractors to monitor satellite *sensor* health. Refer to *Figure* 6 *for* a diagram showing the overall Mission Sensor Processing function.

2.3.3.1.1 Generation of Prepfiles

Mission Sensor data is routed through the Data Formatter which buffers and reformats the data into one-second packages and forwards the data to System 5 for further processing. On System 5, the data is ingested by the "Mission Sensor Data Ingest" process, then stored in raw data files by the "Mission Sensor Data Sort" process (SSPSRT). This process uses information such as satellite identification and start/stop time from the Mission *Sensor* Scheduling file to build a readout information record for each revolution in the Prepfile. The "Mission Sensor Data Sort" process also gets satellite location information, on a minute by minute basis, from the Satellite Location files and stores the data in the Prepfiles in packets which contain 60 seconds of data along with the associated satellite location information.

The "Mission Sensor Data Sort" process segregates the data by sensor type and saves the data in Prepfiles. If there is a system problem where data cannot be directly received from Site III, a data formatter back-up tape is used to load the data through the "Mission Sensor DF Tape Ingest" process (SSPDFT). Refer to *Figure 7 for a* diagram *of* the Generation of Prepfiles process.

A: Organization Responsible: SYSS
B: Equipment: Unisys 1100/91 (System 5)
C: Input: Mission Sensor Data from the Data *Formatter (or* the Data Formatter back-up tape)
PROD*EPHEMbxxxxxx
PROD*INFODP
SSCF*ACFPARAMETER
SSP*CONTROLFILE
Output: Prepfile SSP*IESPREPFILE
Prepfile SSP*BSPREPFILE
Prepfile SSP*BXPREPFILE
Prepfile SSP*IEPREPFILE
Prepfile SSP*J4PREPFILE
Prepfile SSP*JPREPFILE
Prepfile SSP*KPREPFILE

MISSION SENSOR PROCESSING OVERVIEW

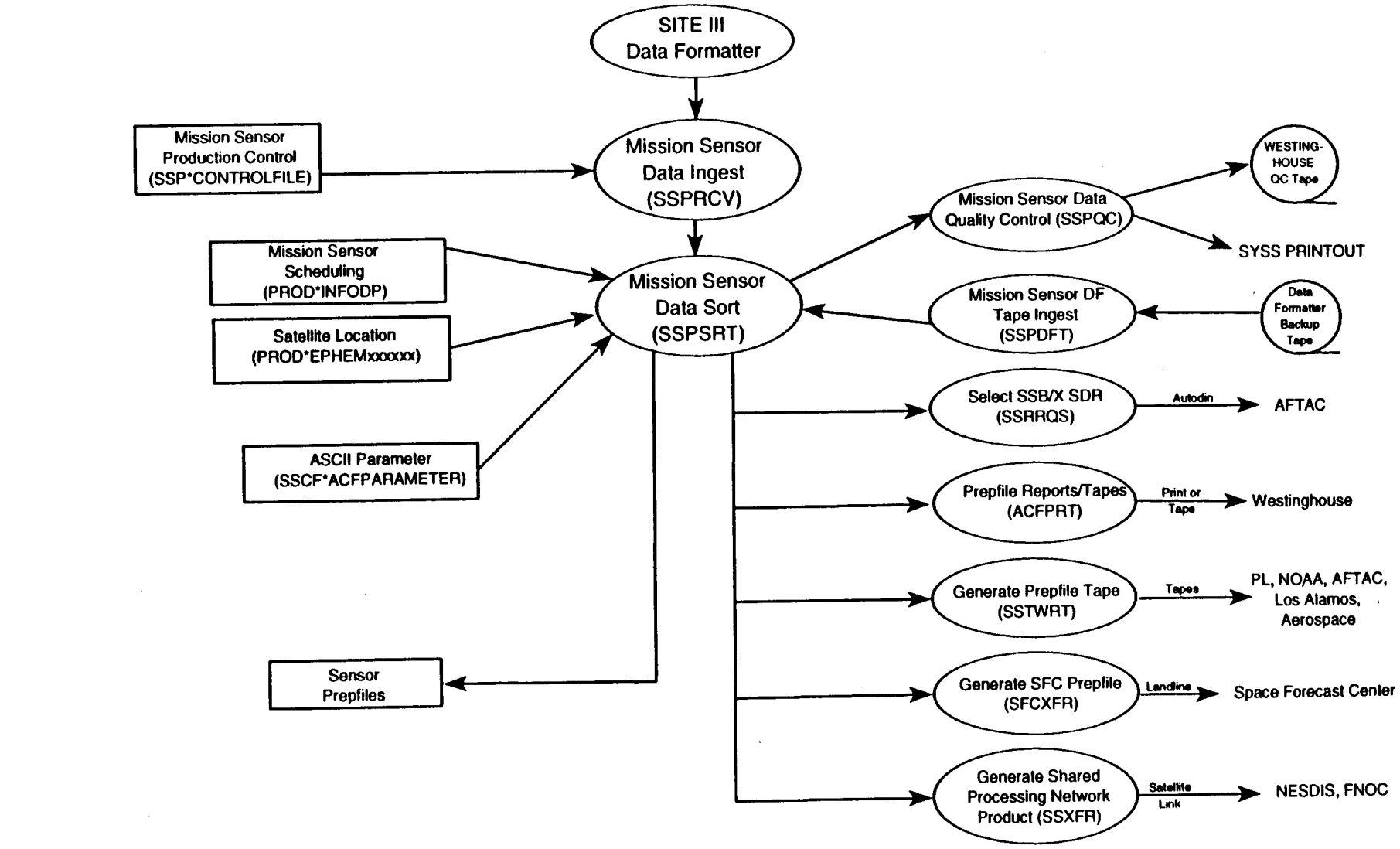
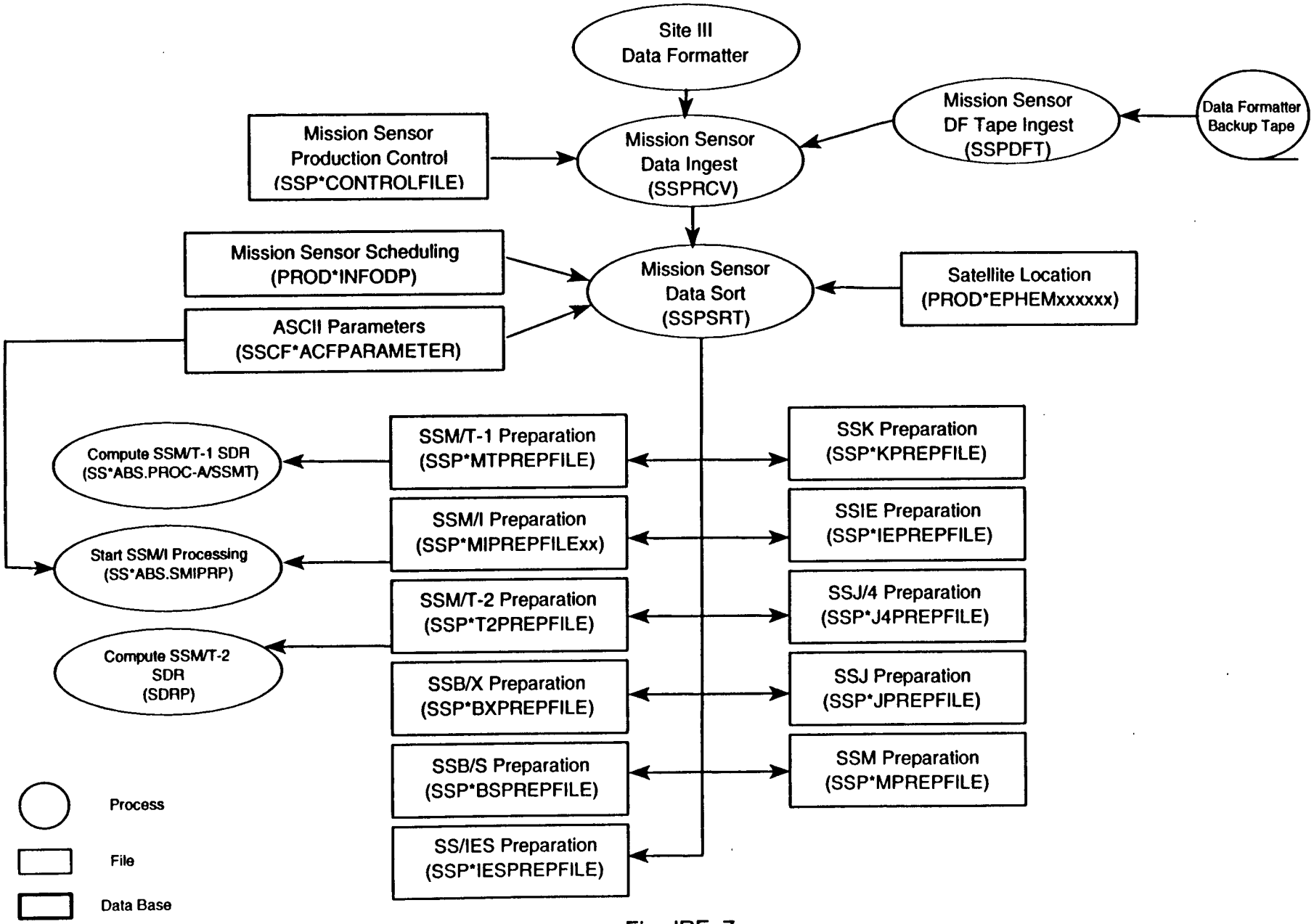


FIGURE 6

GENERATION OF PREPFILES



F' JRE 7

Prepfile SSP*MPREPFILE
Prepfile SSP*MIPREPFILExx
Prepfile SSP*MTPREPFILE
Prepfile SSP*T2PREPFILE

2.3.3.1.2 Generation of Quality Control Statistics

The "Mission Sensor Data Sort" process also generates quality control statistics for each readout that is processed. These statistics are used by the "Mission Sensor Data Quality Control" process (SSPQC) to generate daily and monthly quality control reports. One report is used by SYSS and a second report is sent to the Westinghouse Corporation via magnetic tape. Refer to Figure 8 for a diagram of the Generation of Quality Control Statistics process.

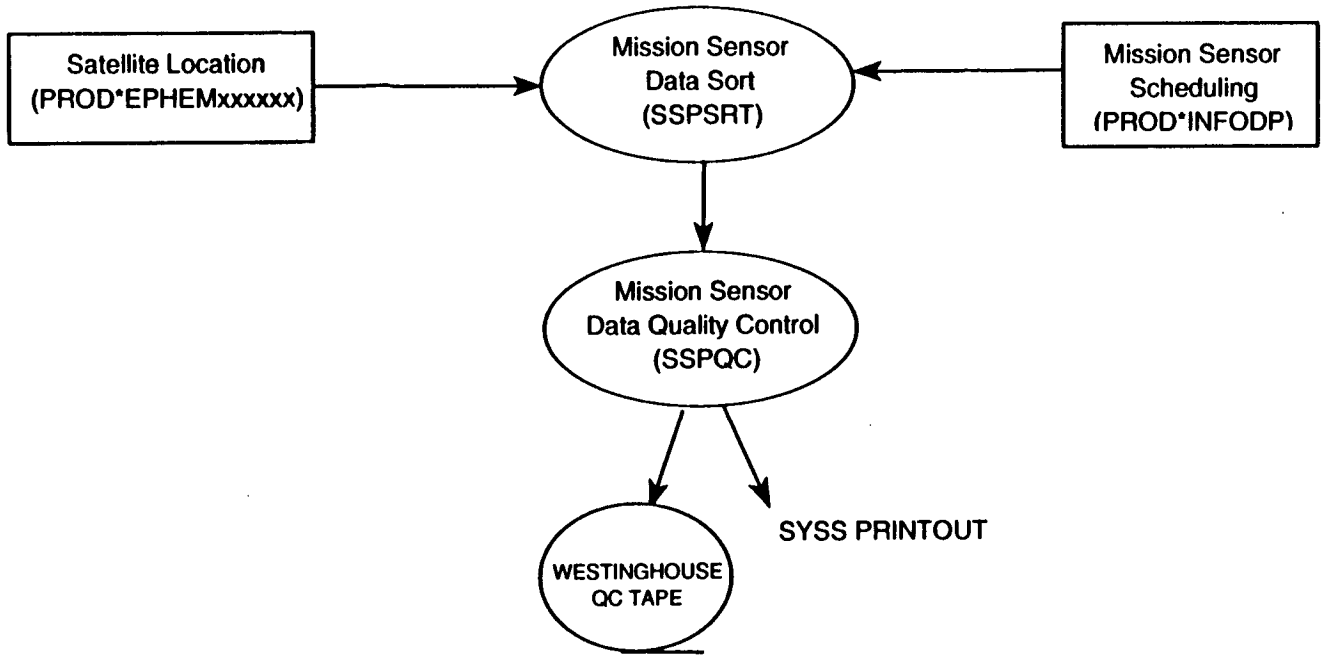
A: Organization Responsible: SYSS
B: Equipment: Unisys 1100/91 (System 5)
C: Input: Mission Sensor Data from the Data Formatter (or the Data Formatter back-up tape)
PROD*EPHEMxxxxxx
PROD*INFODP
Output: SYSS Printout
Westinghouse Quality Control Report and Data Tape

2.3.3.1.3 Generation of AFTAC Data

The "Select SSB/X Sensor Data Records" process (SSRRQS) selects samples of SSB/X sensor data from the SSB/X Pregaration file (SSP*BXPREPFILE) and sends them to the Air Force Tactical Applications Center (AFTAC/TNT) via an AUTODIN line in near real-time. As soon as the data is placed in the SSB/X Preparation file, the "Select SSB/X Sensor Data Records" process checks the Request file (SSR*REQUESTFILE), which is a list of the data that AFTAC is interested in receiving. The AUTODIN Message Format file (SSR*RQSCONFILE) provides the control elements of the data to actually pull out of the Request file. Refer to Figure 9 for a diagram of the Generation of AFTAC Data process.

A: Organization Responsible: SYSS
B: Equipment: Unisys 1100/91 (System 5)
C: Input: PROD*EPHEMxxxxxx
PROD*INFODP

GENERATION OF QUALITY CONTROL STATISTICS



Process

File

Data Base

FIGURE 8

GENERATION OF AFTAC DATA

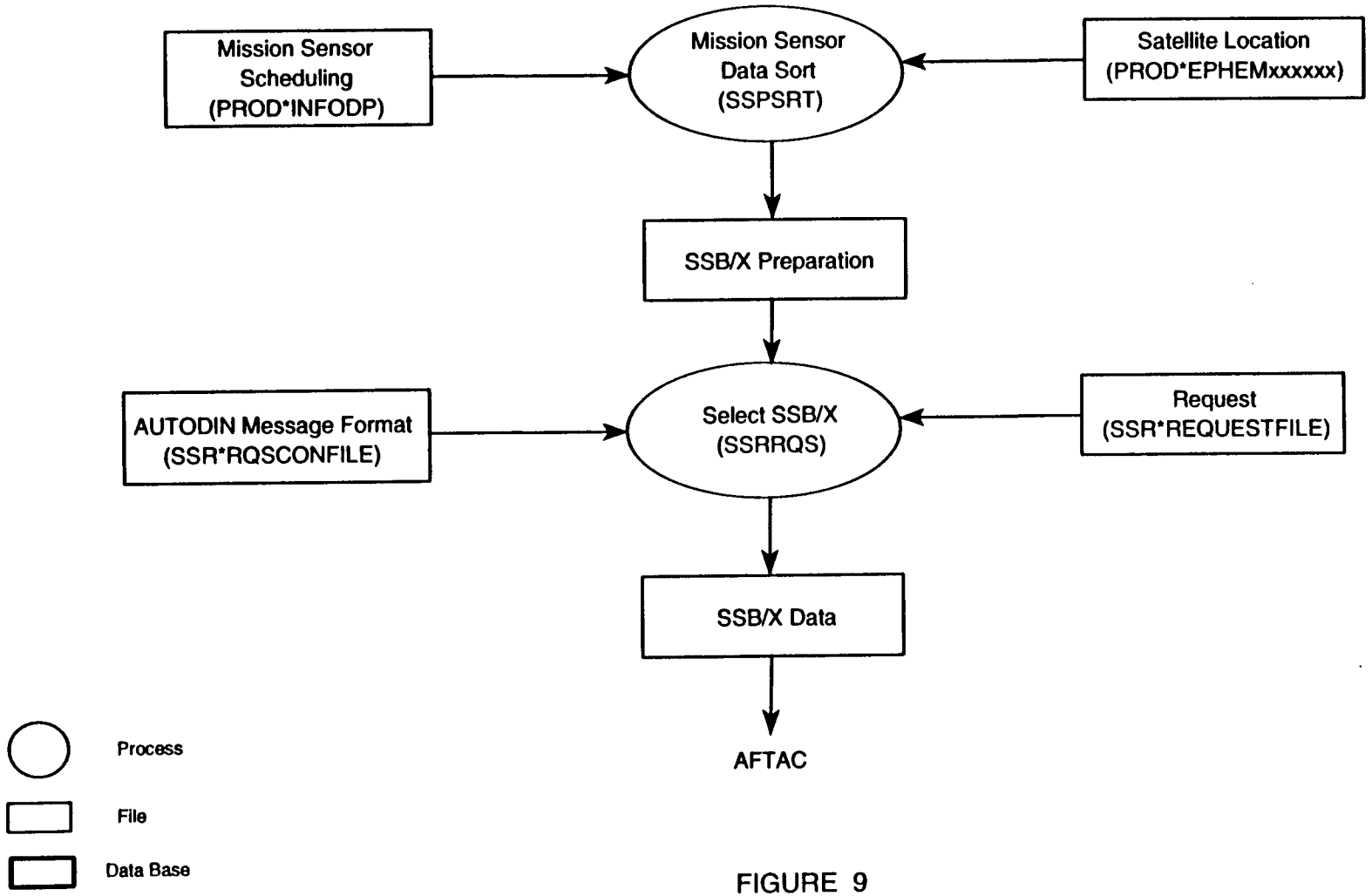


FIGURE 9

SSB/X Prepfile
SSR*REQUESTFILE
SSR*RQSCONFILE
Output: SSB/X data file to AFTAC/TNT (via AUTODIN)

2.3.3.1.4 Generation *of* Westinghouse Prepfile Report/Tapes

The "Prepfile Reports/Tapes" process (ACFPRT) uses information in the ASCII Control file (SSCF*ACFCONTROL), the ASCII Parameters file (SSCF*ACFPARAMETER), and desired mission sensor Prepfiles to generate printed reports in a predefined format *for* the Westinghouse Corporation. The reports and data can also be sent out on magnetic tape. Refer to Figure 10 for a diagram *of* the Generation of Westinghouse Prepfile Report/Tapes process.

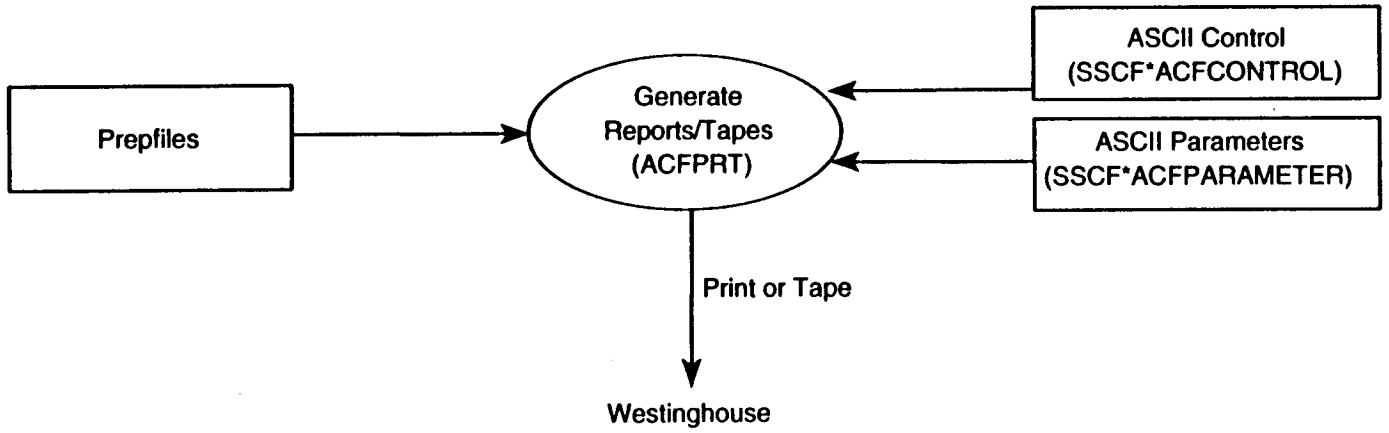
A: Organization Responsible: SYSS
B: Equipment: Unisys 1100/91 (System 5)
C: Input: Prepfiles
SSCF*ACFCONTROL
SSCF*ACFPARAMETER
output: Westinghouse Report and Data Tape

2.3.3.1.5 Generation of Prepfile Tapes

The "Generate Prepfile Tape" process (SSTWRT) copies raw Prepfile data to tapes for use by various government and contractor users. The process uses the Customer Request file (SST*CUSTOMERFILE), which is a list of external customers and defines what Dart *of* the Prepfiles needs to be extracted and provided to each customer. The tapes are sent to Phillips Lab/SUNO, AFTAC/TNT, Los Alamos National Labs, NOM/National Geophysical Data Center (NGDC), and The Aerospace Corporation. These tapes are made twice daily, every 12 hours. One set of the tapes is also kept by AFGWC/SYSS to provide a 31 day archival and recovery capability. Refer to Figure 11 for a diagram of the Generation of Prepfile Tapes process.

A: Organization Responsible: SYSS
B: Equipment: Unisys 1100/91 (System 5)
c: Input: Prepfiles
SST*CUSTOMERFILE (contains tape data requests)
Output: Prepfile data tapes

GENERATION OF WESTINGHOUSE DATA



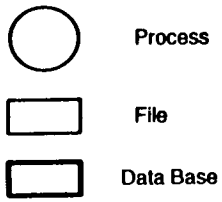
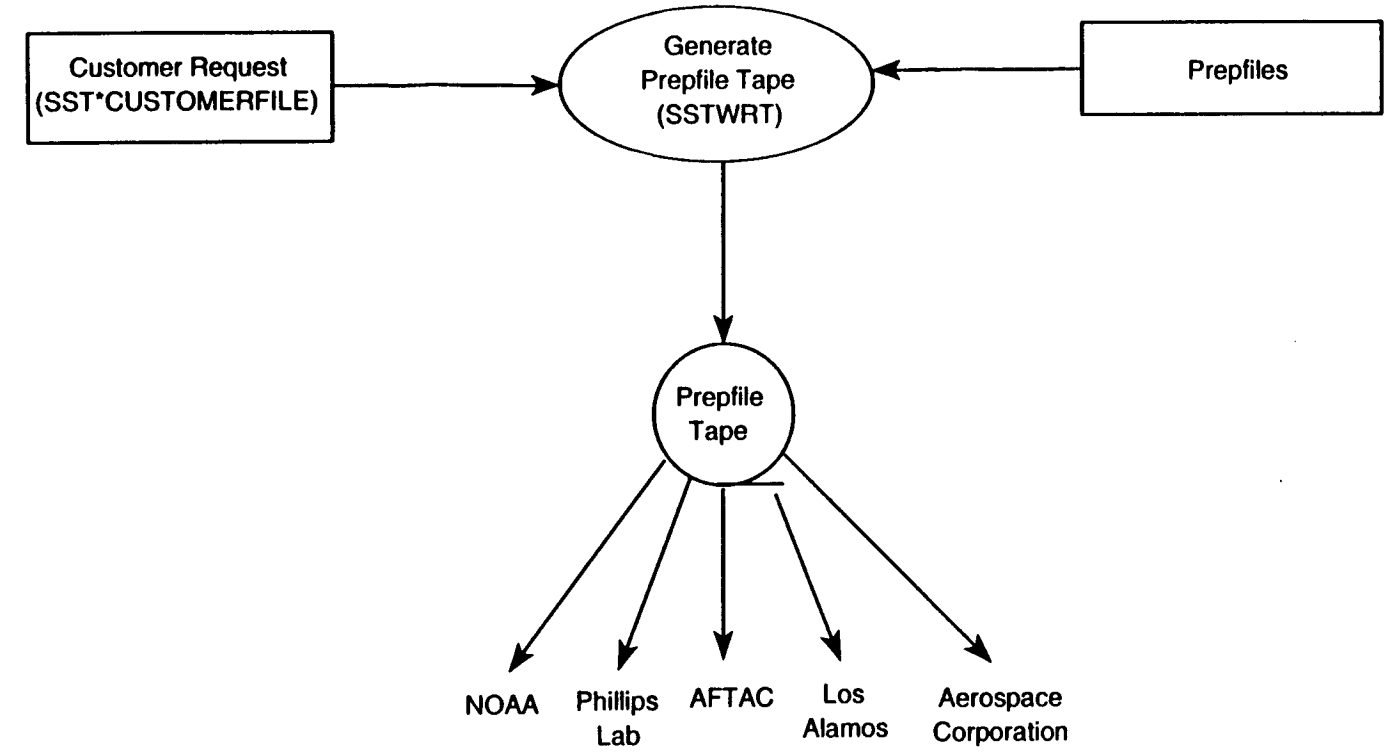


FIGURE 10

GENERATION OF PREPFILE TAPES



Process

File

Data Base

FIGURE 11

2.3.3.1.6 Generation of Space Forecast Center Transfer Files

The "Generate Space Forecast Center Transfer Files" process (SFCXFR) extracts data from the Prepfiles that contain space environment data. The SSJ/4 data is being sent at this time; SS/IES and SSM are planned in the near future (1992-1993). The process obtains routing and transfer control information from the Transfer Control file (SS*XFRCNTLFILE). The transfer is done via the SFC Transfer File (SFC*AAAPBBHHMMSS, where SFC is the Space Forecast Center Identifier; AAA is the type of data; P stands for "plus"; BB is the readout's R+ number; HH is the hour the file was created; MM the minutes after the hour the file was created; and SS is the seconds after the minute the file was created). The actual transfer takes place as soon as each satellite revolution of data is received in System 5. Refer to Figure 12 for a diagram of the Generation of Space Forecast Center Transfer Files process.

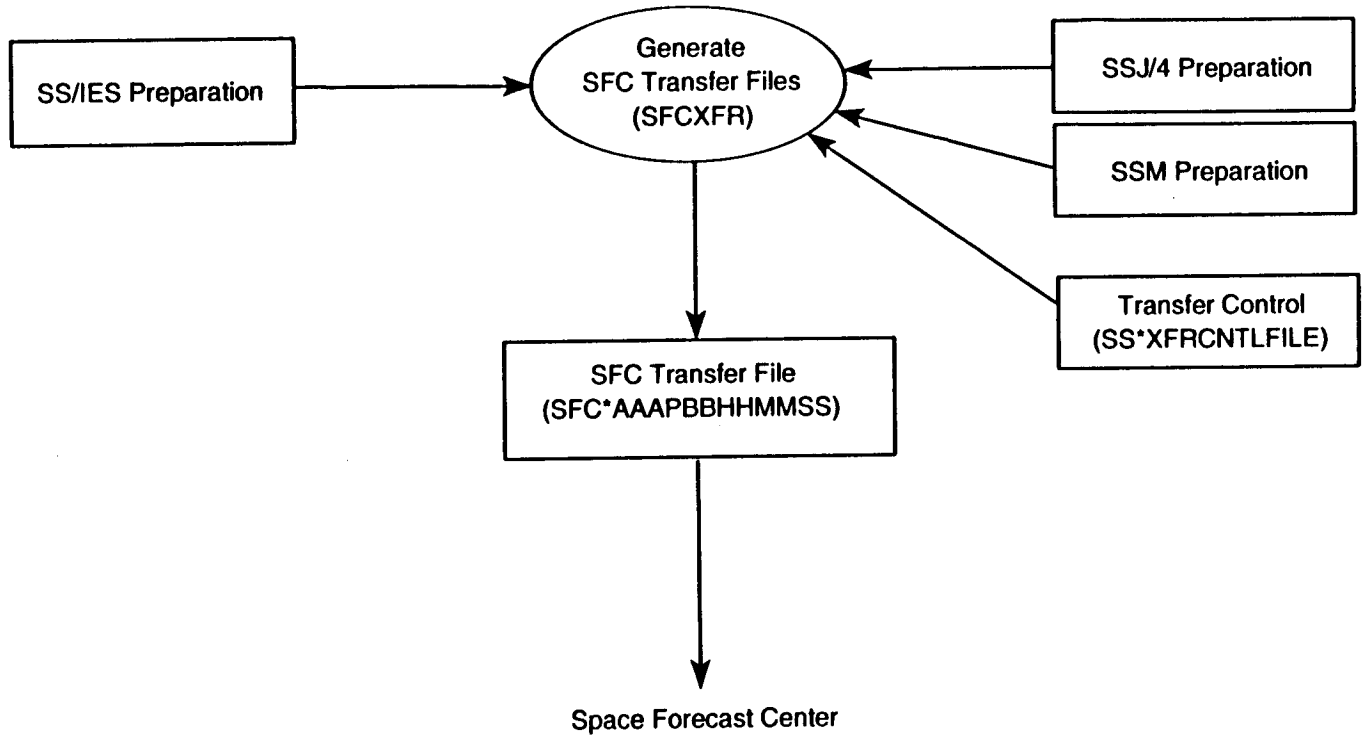
A: Organization Responsible: SYSS
B: Equipment: Unisys 1100/91 (System 5)
C: Input: SS/IES Prepfile
SSJ/4 Prepfile
SS*XFRCNTLFILE
SSM Prepfile
Output: SFC*AAAPBBHHMMSS

2.3.3.1.7 Generation of Shared Processing Network Product

The "Generate Shared Processing Network Product" process (SSXFR) obtain8 SSM/T, SSM/T-2, and SSM/I data from the appropriate Prepfiles for transmission to the National Environmental Satellite Data Information Service (NESDIS), FNOC and the Naval Oceanographic Center. The transfer is done via the NESDIS Transfer File (WXAAAA● BBCCCCCPDD, where WX is the DMSP prefix; AAAA is the satellite identification number; BB is the first two letters of the Prepfile; CCCCC is the readout revolution number; P stands for "plus"; and DD is the readout's R+ number). The data is sent over landlines from the SDHS, and is done after each satellite readout. Refer to Figure 13 for a diagram of the Generation of Shared Processing Network Product process.

A: Organization Responsible: SYSS
B: Equipment: Unisys 1100/91 (System 5)

GENERATION OF SPACE FORECAST CENTER TRANSFER FILES



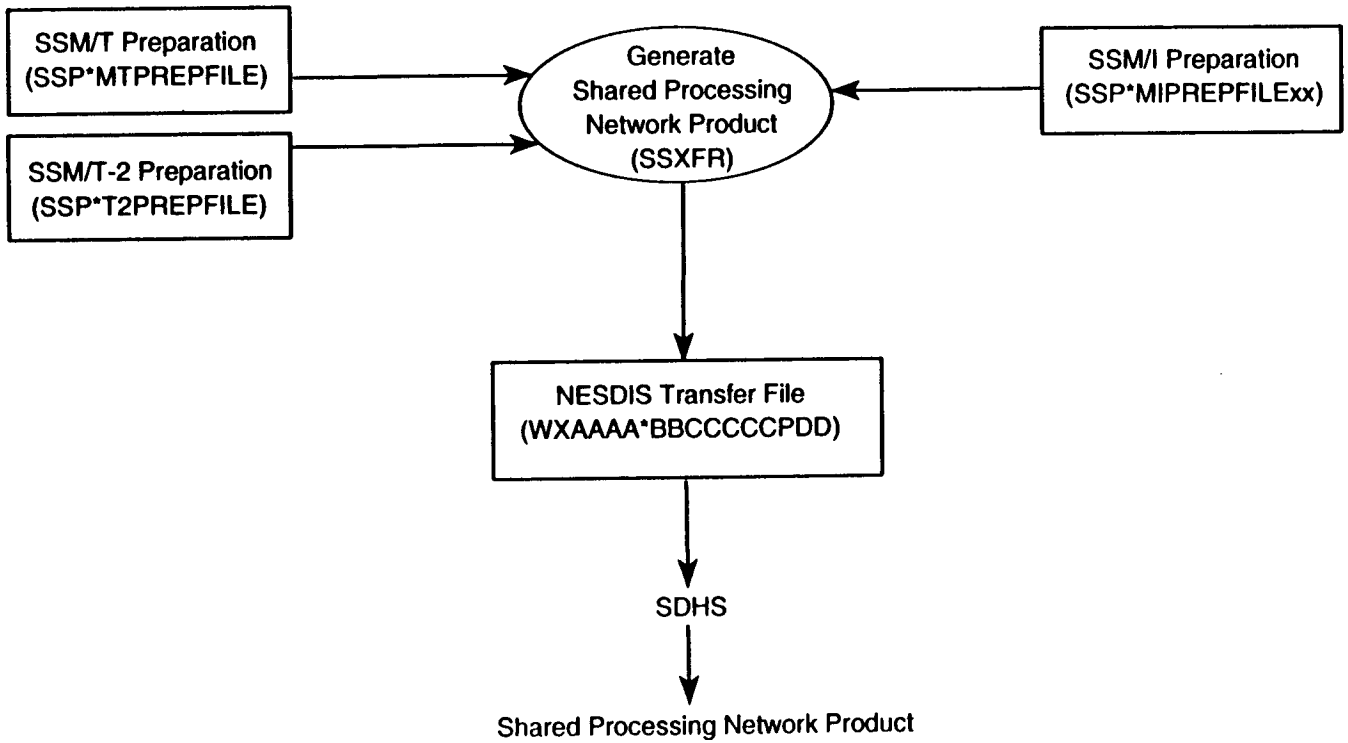
Process

File

Data Base

FIGURE 12

GENERATION OF SHARED PROCESSING NETWORK PRODUCT



Process

File

Data Base

FIGURE 13

C: Input: SSM/T Prepfile
SSM/T-2 Prepfile
SSM/I Prepfile
Output: WXAAAA*BBCCCCCPDD

2.3.3.2 Microwave Temperature Sounder (SSM/T-1)

The Microwave Temperature Sounder is a seven channel, seven frequency, passive microwave sounder that senses in the 50 to 60 GHz band. This instrument measures microwave radiation emitted from different heights within the atmosphere. The data provides forecasters profiles of temperature, height, and thickness versus altitude, and tropopause temperature. The environmental data provided by the SSM/T-1 is incorporated into the AFGWC Upper Air Database (XTPRB). Customers can access the database for applications such as analysis and prognostic models, aircraft routing and refueling, global cloud analysis, severe weather point analysis and warnings, point analysis anywhere on the globe, tropical storm analysis and forecast, airfield forecasts, mission tailored forecasts for the Air Force and Army, and classified project tasks.

Processing of SSM/T-1 data starts with the process "compute SSM/T-1 Sensor Data Records" (SS*ABS.PROC-A/SSMT1) which computes earth located, calibrated Kelvin brightness temperatures (SDRs) from raw counts (electric voltages from the T-l sensor). An SDR is generated for each of the seven channels within one scene (footprint) and there are seven scenes per scan. The process uses data from the SSM/T-1 Preparation file (SSP*MTPREPFILE) which contains the formatted raw counts and ephemeris information. The Mission Sensor Production Control file (SSP*CONTROLFILE) and the Binary Parameters file (SSCF*CFPARAMETERS) are inputs that provide format information from the Hemispheric Fixed Field Database (RFIX64) to obtain geography type and terrain elevation data. SSM/T-1 antenna temperatures (SSMT*CALGAIN),temperatures that are not corrected for antenna pattern effects (i.e.,side lobes), are calculated first and then are used in the Brightness temperature calculation. The process stores the generated SDRs in the SSM/T-1 Brightness Temperature file (SSMT*BRTEMP). Refer to Figure 14 for a diagram of the SSM/T-1 Sensor Processing software.

The "Compute SSM/T-1 Environmental Records" automatically starts after the "Compute SSM/T-1 Sensor Data records" process

SSM/T-1 SENSOR PROCESSING

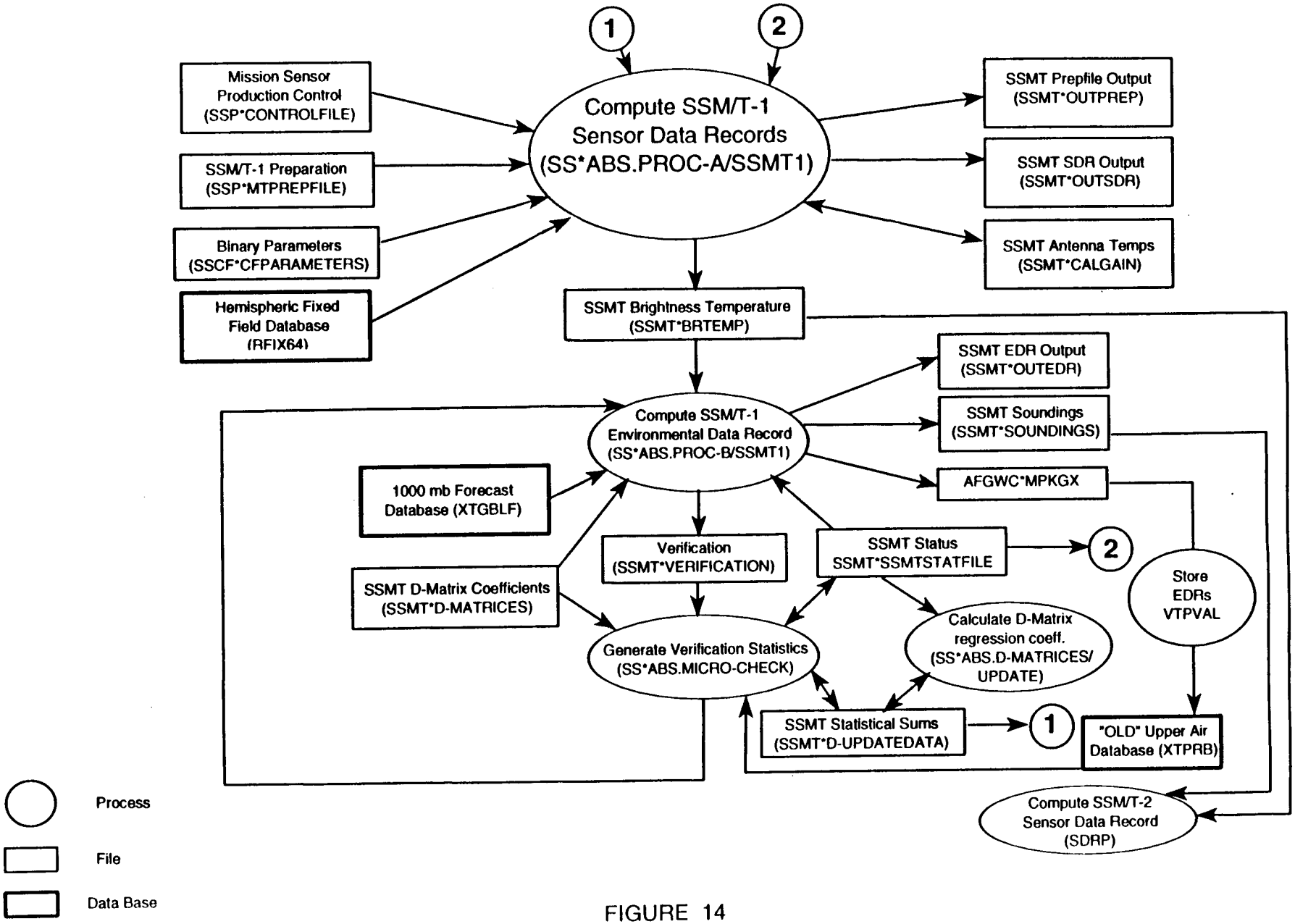


FIGURE 14

finishes and calculates a temperature, height, and thickness at mandatory pressure levels, as well as tropopause temperature and pressure. This profile (sounding) is called an Environmental Data Record (EDR) and is calculated for each scene that is not determined to be precipitation contaminated. The process requires information from the 1000-mb height forecast (XTGBLF) to stack the thicknesses on to determine the height parameters in the profiles. The process calculates an EDR by multiplying the seven SDRs per scene by matrix regression coefficients stored in the SSM/T-1 D-Matrices file (SSMT*DMATRICES) in a statistical linear regression equation. The EDRs are stored in the SSM/T-1 soundings file (SSMT*SOUNDING). A reduced data density version of the SSMT*SOUNDING file is created called AFGWC*MPKGX (X=0-4 for different revs of T-l data that are simultaneously being processed) which is transferred to update the Upper Air Database (XTPRB), which contains satellite soundings, conventional rawinsonde and rocketsondes, as well as pilot reports. The reduced density version is created due to database limitations of XTPRB. Processing options can be set in the SSM/T-1 residual statistics file (SSMT*SSMTSTATFILE) to control diagnostic print, threshold parameters, and processing controls for the SSM/T-1 system. The raw count and ephemeris data can be written to an output file (SSMT*OUTPREP), the SDRs can be written to an output file (SSMT*OUTSDR), and the EDRs can be written to an output file (SSMT*OUTEDR) which are all formatted for easy imaging display on a workstation or VAX hardware environment.

The "Compute SSM/T-1 Environmental Data Record" process also sends the EDRs to the Verification file (SSMT*VERIFICATION). This file stores eight 3-hour cycles of SSM/T-1 EDRs for use by the "Generate Verification Statistics" process (SS*ABS.MICRO-CHECK). This process is started manually once per day to calculate root mean square (RMS) and bias statistics. The process co-locates SSM/T-1 profiles with conventional rawinsonde and rocketsonde soundings using 3-hour temporal and 100 NM spatial match criteria. The RMS and bias for temperature, height, thickness, and tropopause are stored in the SSM/T-1 residual statistics file (SSMT*SSMTSTATFILE) for use by the analyst to monitor system performance. If a match meets a user specified quality threshold, the process generates a data measured (DM) and data calculated (DC) pair and stores it to the statistical sums file (SSMT*D-UPDATEDATA). The "Calculate D-Matrix Regression Coefficient" process is manually started once per day to determine if new D-Matrix coefficients should be

generated for future use by the "Compute Environmental Data Record" process. It uses the DM/DC pairs in the statistical sums file (SSMT*D-UPDATEDATA) to calculate a variety of statistical tests regarding sample size and quality. If these tests are passed, it updates the *error* covariance coefficients and generates new D-Matrix regression coefficients and stores them to g-track tapes for testing and possible implementation in the D-Matrices regression file (SSMT*D-MATRICES) for use by the "Compute Environmental Data *Record"* process to improve the quality of the SSM/T-1 soundings. Both the "Generate Verification Statistics" and "Calculate D-Matrix Regression Coefficients" process provides a mechanism to drive the SSM/T-1 profile retrieval towards a conventional derived profile which is considered to be ground truth.

A: Organization Responsible: SYSS
B: Equipment: Unisys 1100/91 (System 5)
C: Input: RFIX64 Database
SS*ABS.D-MATRICES/UPDATE
SS*ABS.MICRO-CHECK
SS*ABS.PROC-A/SSMT1
SS*ABS.PROC-B/SSMT1
SSCF*CFPARAMETERS
SSMT*D-MATRICES
SSMT*D-UPDATEDATA
SSMT*VERIFICATION
SSMT*SSMTSTATFILE
SSP*CONTROLFILE
SSP*MTPREPFILE
XTGBLF Database
XTPRB Database
Output: SSMT*CALGAIN
SSMT*BRTEMP
SSMT*OUTEDR
SSMT*OUTPREP
SSMT*OUTSDR
SSMT*SOUNDINGS
SSMT*VERIFICATION
XTPRB Database

2.3.3.3 Microwave Water Vapor Sounder (SSM/T-2)

Four channels from the SSM/T-1 sensor augment five from the Microwave Water Vapor Sounder (SSM/T-2) to generate moisture

profiles. The SSM/T-2 sensor has a higher resolution than the SSM/T-1 with 16 SSM/T-2 scenes for each SSM/T-1 scene. Thus, the process to take raw-data from ingest to database takes about ten minutes due to the higher density of the data. The data is currently being processed to support the on-going sensor calibration and validation effort to gain information on the new SSM/T-2 sensor. Plans call for this data to be included in the Satellite Atmospheric Database (XUASAT) residing on the Unisys with the SSM/T-2 data for eventual use by the ASPAM model.

The process starts when the "Compute SSM/T-1 Environmental Data Record" process finishes. The "Compute SSMT/T-2 Sensor Data Records" process is similar to the "Compute SSM/T-1 Sensor Data Records" process, which converts raw radiometric counts to calibrated and geolocated brightness temperatures in Kelvin. Inputs come from the SSM/T-2 Preparation file, the ASCII Parameters file, SSMT Soundings file, SSMT Brightness Temperature file, the Hemispheric *Fixed* Field Database (XFIX64), Northern and Southern Hemispheric Nephanalysis Database (XNNEFA, XSNEFA) 'and RNGADB Database. Refer to *Figure* 15 for a diagram of the SSM/T-2 Sensor Processing process.

The output from the "Compute SSMT/T-2 Sensor Data Records" process is an SDR that goes to the Sensor Data Record file (SDRFILE). This is the main input to the "Build SSM/T-2 Environmental Data Record" process (EDRP), which is a process similar to the "Compute SSM/T-1 Environmental Data Record" process for the SSM/T-1 sensor. The "Compute SSM/T-2 Environmental Data Record" process sends the EDR containing relative and specific humidity and *water vapor mass to* the EDRX file for transfer to populate the Satellite Atmospheric Database.

The Satellite Atmospheric Database is used by various users at AFGWC and contains satellite atmospheric data. The Satellite Atmospheric Database currently has moisture soundings only; eventually it will also contain SSMIS sensor data. SSMIS is *a* planned sensor for the 1997/98 time frame that will be a single sensor performing the functions of the current SSM/T-1, SSM/T-2 and SSM/I sensors, only at a better resolution. The SSMIS will also provide upper atmospheric soundings (upper air temperature and thickness profiles).

The "Compute SSM/T-2 Environmental Data Record" process writes the EDRs that are co-located to the rawinsondes locations

SSM/T-2 SENSOR PROCESSING

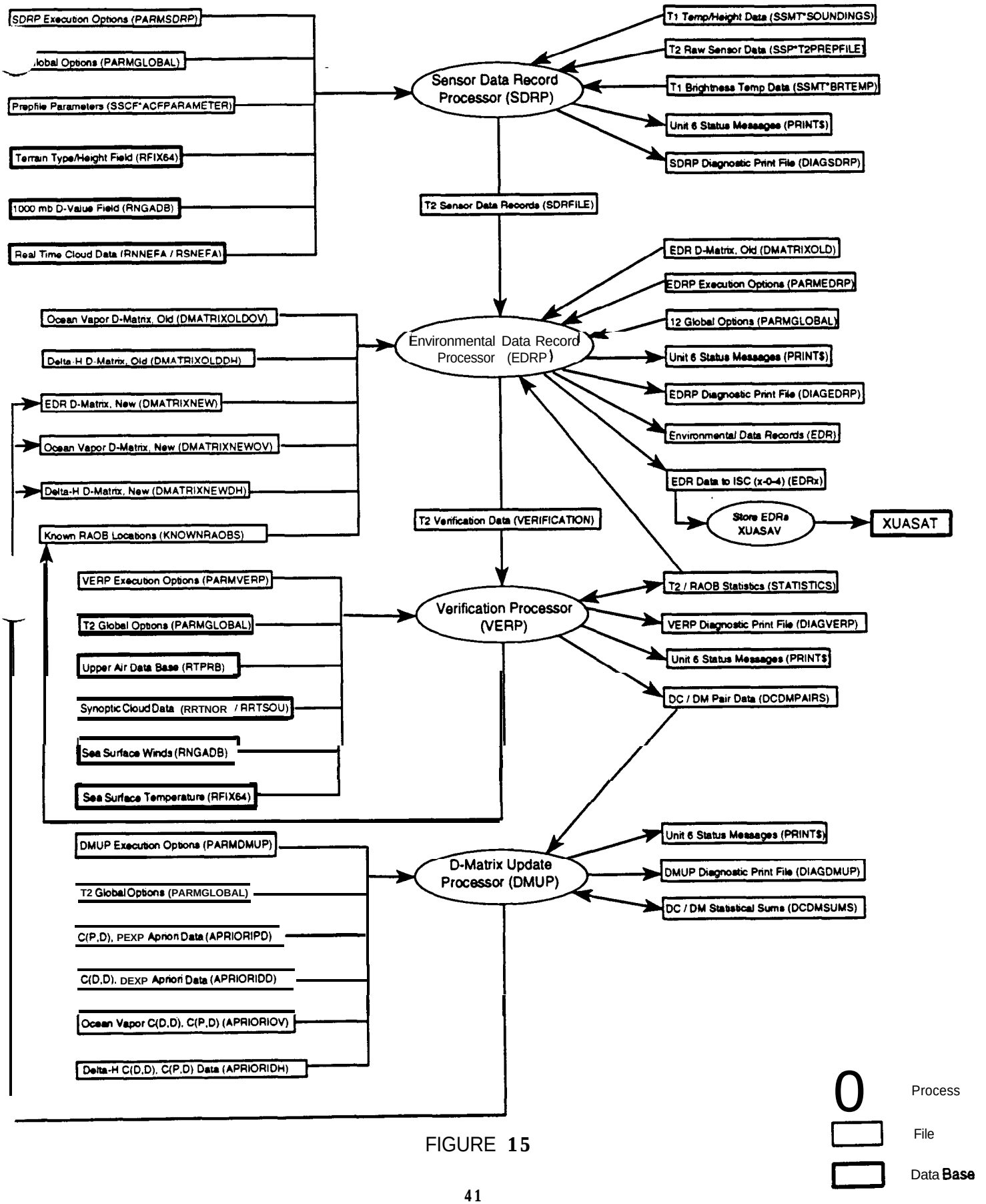


FIGURE 15

in the RAOB file (KNOWNRAOBS) and to the verification file (VERIFICATION). The verification file is used by the "Verification" process, which is run twice a day, to provide RMS and bias statistics-stored in the statistics file (STATISTICS) to show performance comparisons between SSM/T-2 profiles and conventional rawinsondes. High quality SSM/T-2 to rawinsondr matches are run through a radiative transfer model within the "Verification" process to calculate data measure (DM) and data calculated (DC) pairs and are stored in the DC/DM pairs file (DCDMPAIRS). The "Update D-Matrices* process uses the DC/DM pairs to generate running statistical sums stored in the DC/DM sums file (DCDMSUMS) to run a variety of statistical quality checks to determine whether the D-Matrix regression coefficients (DMATRIXNEW) should be updated. This process allows the analyst to improve SSM/T-2 retrievals by forcing the SSM/T-2 profiles to look more like rawinsonde moisture profiles, which are considered to be ground truth.

A: Organization Responsible: SYSS
B: Equipment: Unisys 1100/91 (System 5)
c: Input: XNNEFA, XSNEFA Database
RFIX64 Database
RNGADB Database
SSCF*ACFPARAMETER
SSMT*BRTEMP
SSMT*SOUNDINGS
SSP*T2PREPFILE
Output: EDRX
XUASAT Database
SDRFILE
Verification

2.3.3.4 Special Sensor Microwave Imager (SSM/I)

The SSM/I is a seven channel microwave radiometer that measures radiation (dual polarized at 19, 37, and 85 GHz; vertical polarization only for 22 GHz) upwelling from the earth's atmosphere and surface. Clouds are relatively transparent to radiation at these frequencies, so that the entire depth of the atmosphere down to the surface can be measured, not just the cloud tops as for the case of visible and infrared instruments. This allows many atmospheric and surface environmental parameters to be retrieved. These parameters are computed for each complete set of instrument measurements (spaced at 25 km), and are then

gridded into the AFGWC 1/8 Mesh SSM/I database. The environmental data produced from the SSM/I measurements have applications in severe weather, tropical forecasts, agricultural meteorological (AGRMET), cloud analysis, and special support areas.

The SSM/I processing autoxmtically starts for each DMSP satellite with an SSM/I sensor. The first program runs the SSM/I Pre-Processor (SS*ABS.SMIPRP), which determines what type of ephemeris data will be used. First SMIPRP reads the MIPREPFILE to find the most recent unprocessed rev of data, then reads the z-bit file (on-board ephemeris data file) to see if the ephemeris data for that rev is found. If the rev is found, a flag is set so that on board ephemeris data will be used during processing. If the rev is not found or an error occurs during the search, the flag is set so that the predicted ephemeris data will be used. The predicted ephemeris is found in SSP*MIPREPFILExx, where xx refers to the DMSP vehicle identification number. Refer to Figure 16 for a diagram of the SSM/I Sensor Processing process.

The next program run is the "SSM/I Sensor Data Record Processor" (SS*ABS.SMISDP) which generates calibrated and geolocated SSM/I microwave brightness temperatures in the form of SDRs. Inputs to this process come from the Processing Options file (SSMI*NAMELIST), the Trigonometric Table file (SSMI*SMITRIGTAB), the Sensor Specific Constants file (SSMI*SMISENSORxx), the Surface Type file (SSMI*SMISURTYP), the Antenna Pattern Correction file (SSMI*SMIAPCORxx), and the Z-Bit file.

The Processing Options file provides the processing options for the "SSM/I SDR Processor". The Trigonometric Table file contains the trigonometric table for calculating "I" and "J" points (hemispheric coordinates) used in the "SSM/I SDR Processor". The Sensor Specific Constants file is satellite dependent and contains specific constants used for correction and calibration of raw satellite data counts. The Surface Type file provides information on the earth surface type, such as land, water, ice, etc. The Antenna Pattern Correction file contains antenna pattern correction constant (APC) coefficients and indices. The SSM/I Preparation file contains the raw data blocks, ephemeris information, and satellite time references.

Outputs from the "SSM/I Sensor Data Record Processor"

SSM/I SENSOR PROCESSING

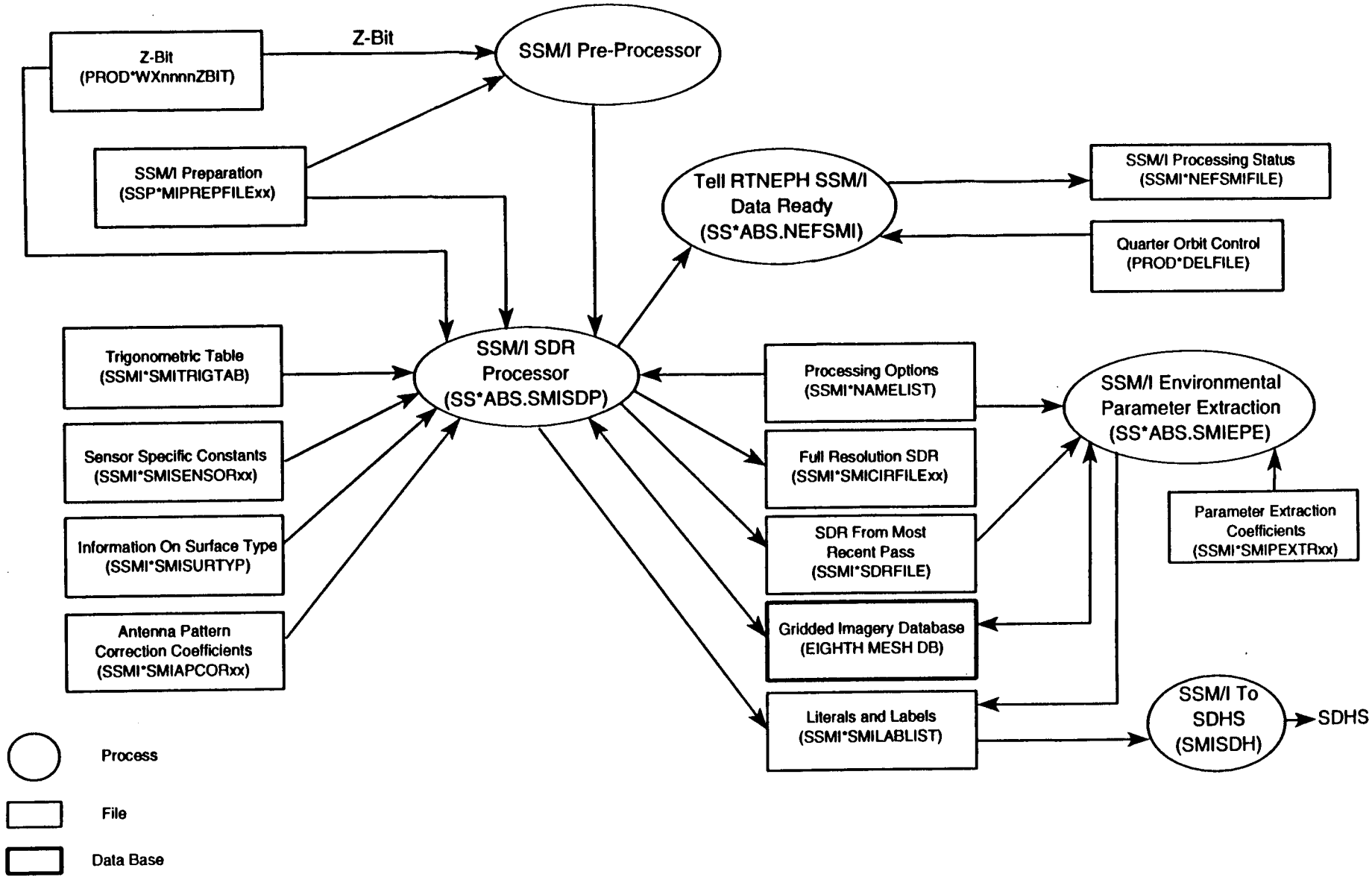


FIGURE 16

include the Full Resolution SDR file (SSMI*SMICIRFILExx), the SDR From Most Recent Pass file (SSMI*SDRFILE), and the Literal8 and Labels file (SSMI*SMILABLIST). The Full Resolution SDR file is a full resolution SDR circular file for the SSM/I sensor which contains sensor specific history information and is read by the Real-Time Nephanalysis Model. The SDR From Most Recent *Pass* file contains only SDR's *from* the specific satellite pass that was processed. The Literals and Labels file is *a* label list containing literals and labels which have been updated in the Gridded Imagery Databases (1/8 Mesh SSMI database).

In addition, data is received *from* and returned to the SSM/I Gridded Imagery Database, also known as the 1/8 Mesh Database, the main database of gridded imagery. Some resolution is lost when SSM/I data is gridded into the Gridded Imagery Database.

The next step is to access the "Tell RTNEPH SSM/I Data Ready" process (SS*ABS.NEFSMI) which notifies the Real-Time Nephanalysis Model that SSM/I data is ready to be used. The "Tell RTNEPH SSM/I Data Ready" process receives input from the Quarter-Orbit Control file. The process also updates the SSMI Processing Status file (SSMI*NEFSMIFILE) which is polled by RTNEPH's interface routine to determine the latest revolution *of* data that has been processed by SSM/I.

After the "Tell RTNEPH SSM/I Data Ready" process finishes, the "SSM/I Environmental Parameter Extraction" process (SS*ABS.SMIEPE) is *started.* This process is the EDR processor for the SSM/I sensor and utilizes the "SDR From Most Recent Pass" file to generate EDR's and update the EDR portion of the Gridded Imagery Database. Additionally, the process receives inputs *from* the Parameter Extraction Coefficients file (SSMI*SMIPEXTRxx) and the Gridded Imagery Database. The Parameter Extraction Coefficients file contains coefficients which are used to convert sets of temperatures into environmental parameter values. Data is output to the SSM/I Gridded Imagery Database and the Literal8 and Labels file.

Data from Literals and Labels file is sent to the "SSM/I *To* SDHS" process (SMISDH) which transmits SSM/I data to the SDHS at eighth-mesh resolution.

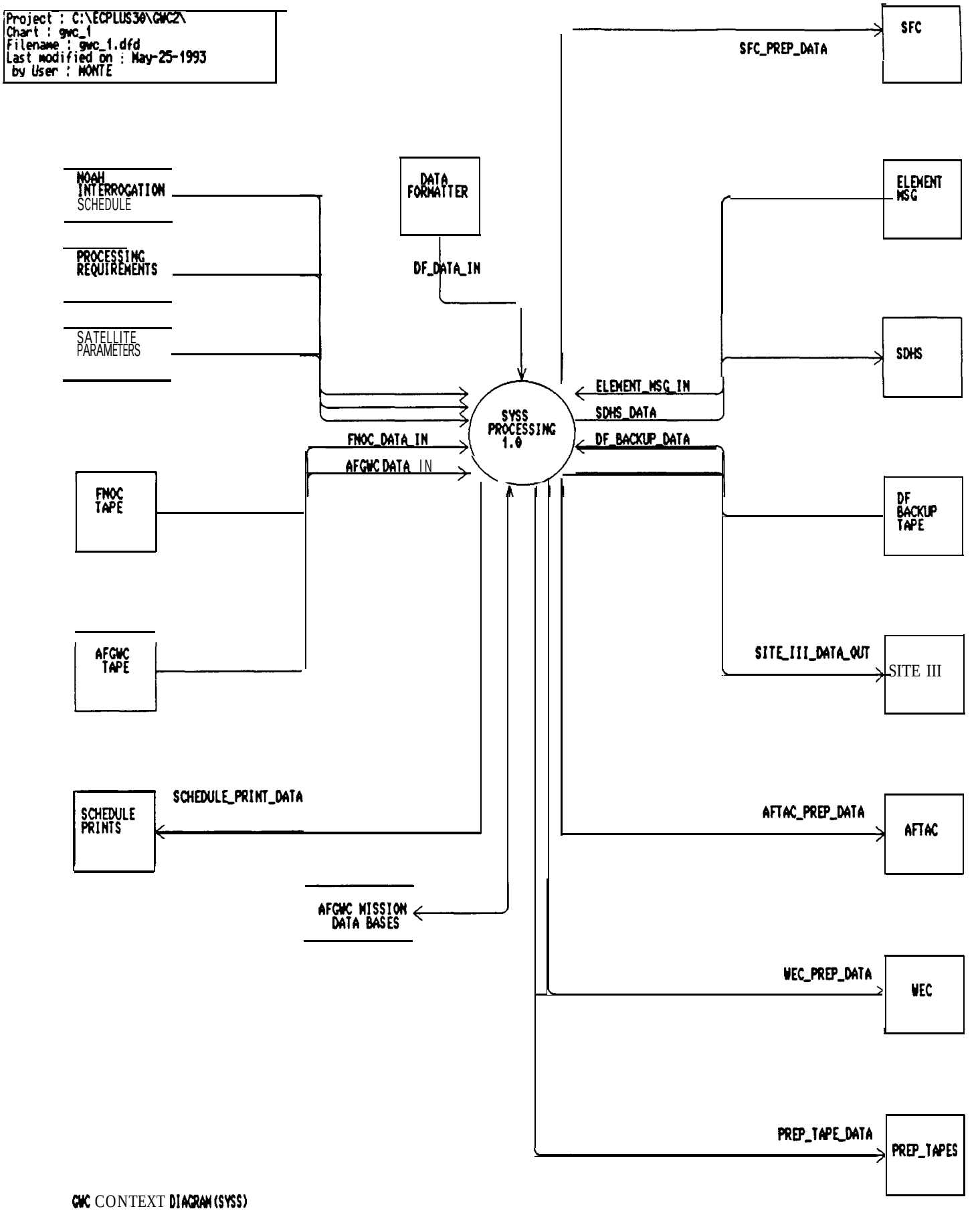
A: Organization Responsible: SYSS
B: Equipment: Unisys 1100/91 (System 5)

C: Input: Gridded Imagery Database
PROD*DELFILE
PROD*WXnnnnZBIT
SSMI*NAMELIST
SSMI*SDRFILE
SSMI*SMIAPCORxx
SSMI*SMIPEXTRxx
SSMI*SMISENSORxx
SSMI*SMISURFTYPE
SSMI*SMITRIGTAB
SSP*MIPREPFILExx

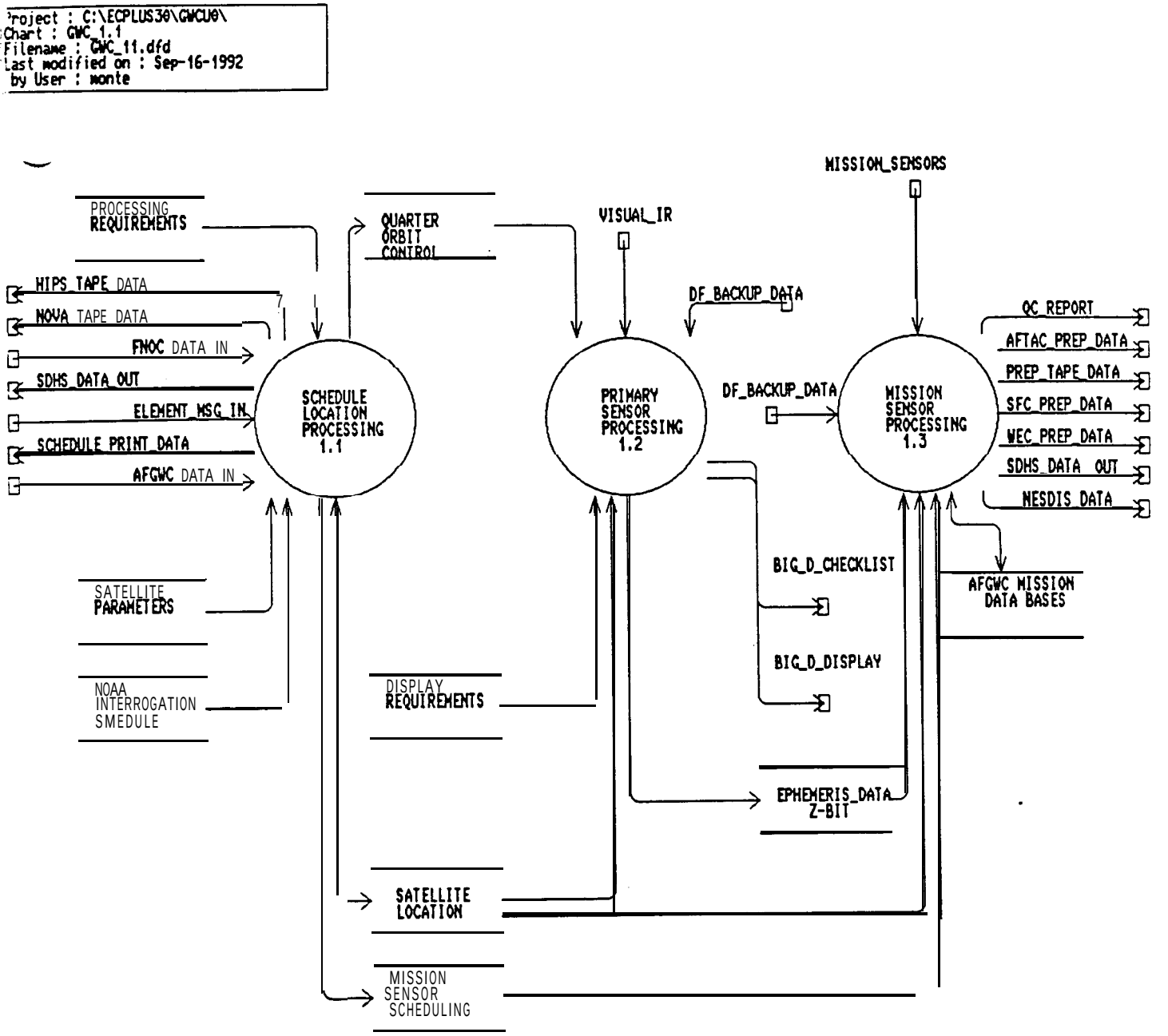
Output: Gridded Imagery Database
(1/8 mesh SSM/I database)
SDHS (via SMISDH)
SSMI*NEFSMIFILE
SSMI*SDRFILE
SSMI*SMICIRFILExx
SSMI+SMILABLIST

APPENDIX A

CASE DIAGRAMS

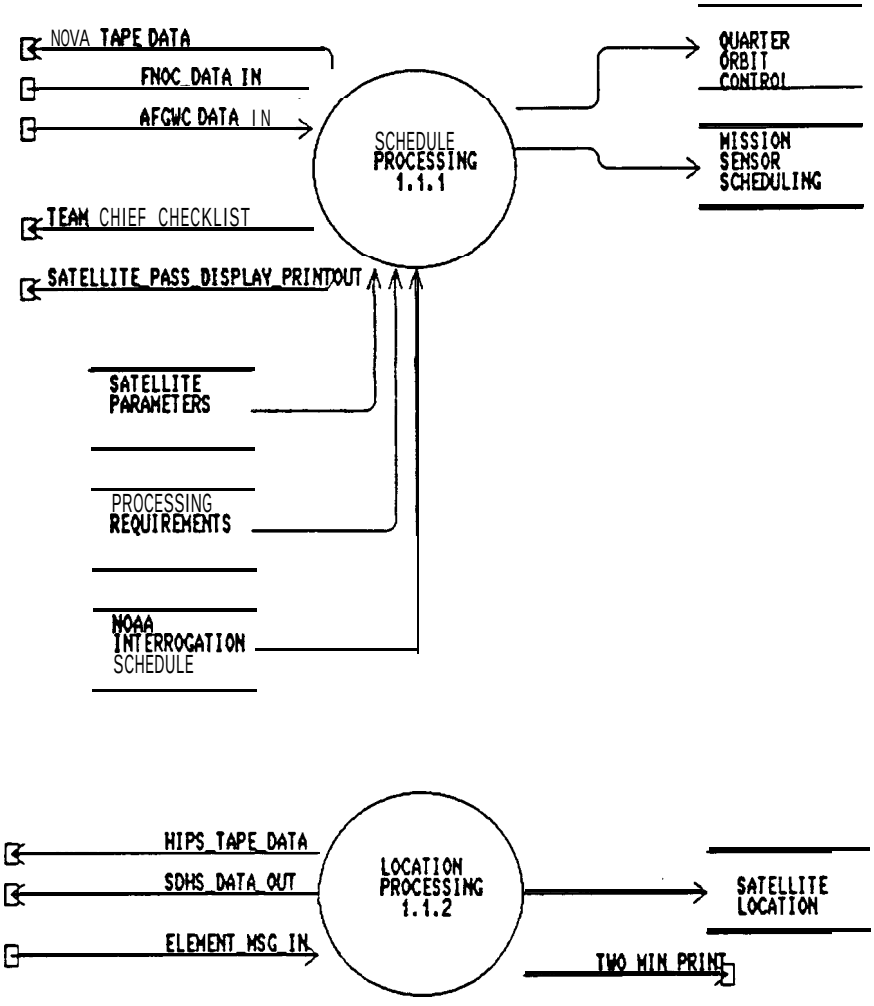


GWC CONTEXT DIAGRAM (SYSS)


Project : C:\ECPLUS30\GWCU0\
Chart : GWC_1.1
Filename : GWC_11.dfd
Last modified on : Sep-16-1992
by User : monte
MISSION_SENSORS
PROCESSING REQUIREMENTS
QUARTER ORBIT CONTROL
VISUAL_IR
DF_BACKUP_DATA
HIPS_TAPE_DATA
NOVA_TAPE_DATA
FNOC DATA IN
SDHS_DATA_OUT
ELEMENT_MSG_IN
SCHEDULE PRINT_DATA
AFGWC DATA IN
SCHEDULE LOCATION PROCESSING 1.1
PRIMARY SENSOR PROCESSING 1.2
DF_BACKUP_DATA
MISSION SENSOR PROCESSING 1.3
QC_REPORT
AFTAC_PREP_DATA
PREP_TAPE_DATA
SFC_PREP_DATA
WEC_PREP_DATA
SDHS_DATA_OUT
NESDIS_DATA
SATELLITE PARAMETERS
BIG_D_CHECKLIST
AFGWC MISSION DATA BASES
BIG_D_DISPLAY
NOAA INTERROGATION SMEDULE
DISPLAY REQUIREMENTS
EPHEMERIS_DATA Z-BIT
SATELLITE LOCATION
MISSION SENSOR SCHEDULING

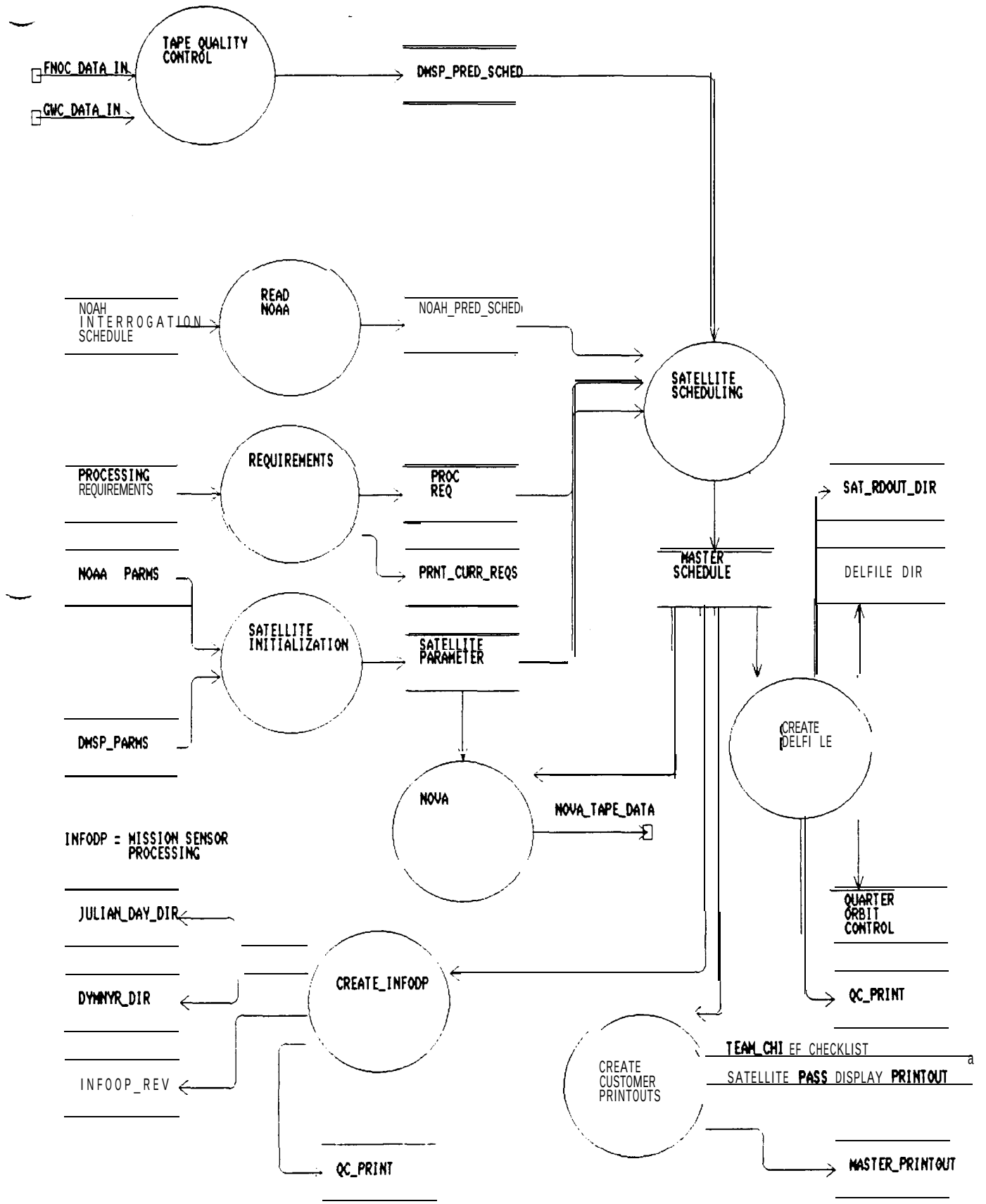
Project : C:\ECPLUS30\GWCU0\
Chart : GWC_111
Filename : GWC_111.dfd
Last modified on : Sep-16-1992
by User : monte

SCHEDULE LOCATION PROCESSING 1.1



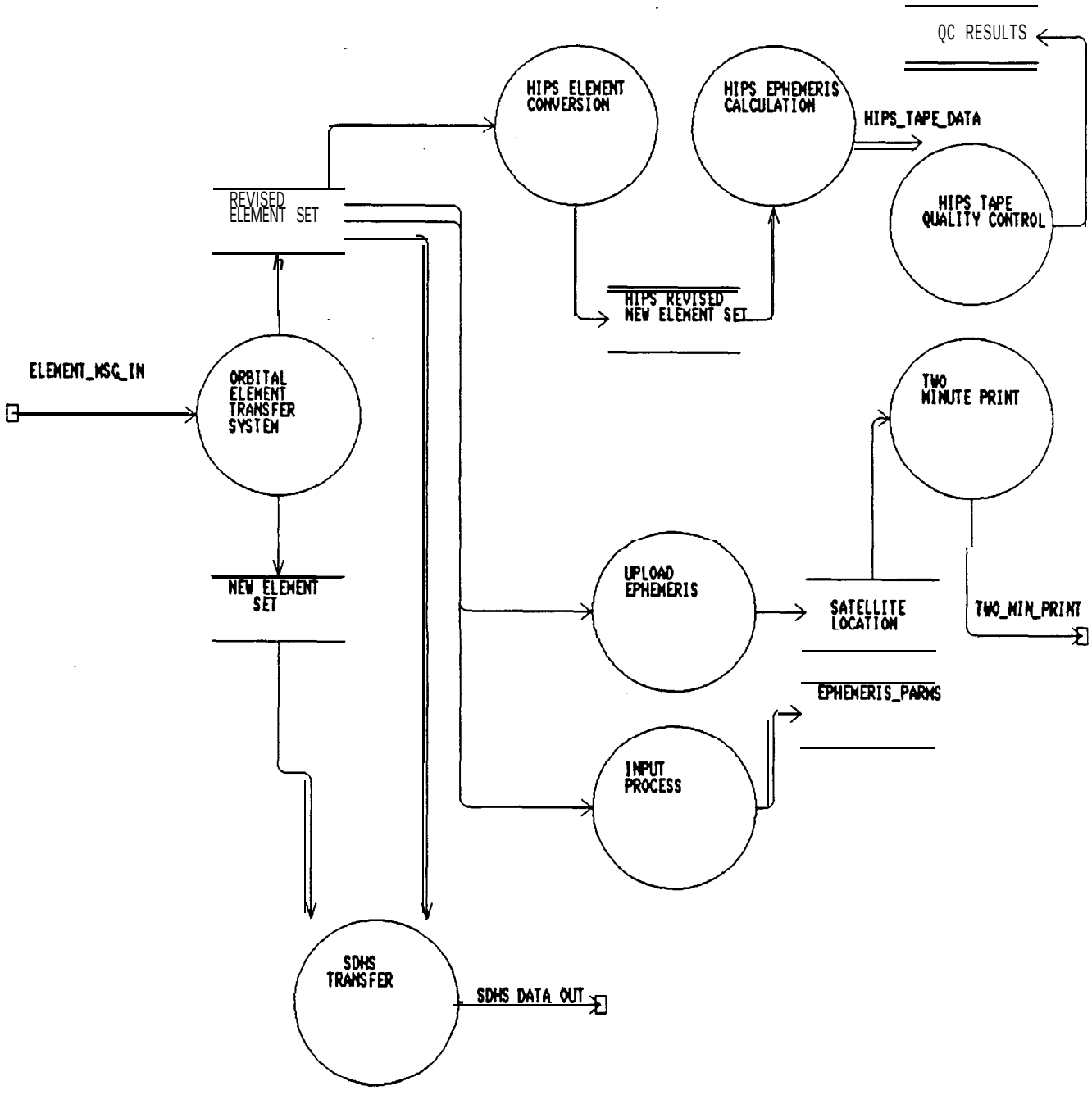
Project : C:\ECPLUS30\GWC2\
Chart : GWC1111
Filename : GWC_1111.dfd
Last modified on : May-26-1993
by User : MONTE

SCHEDULE PROCESSING
1.1.1



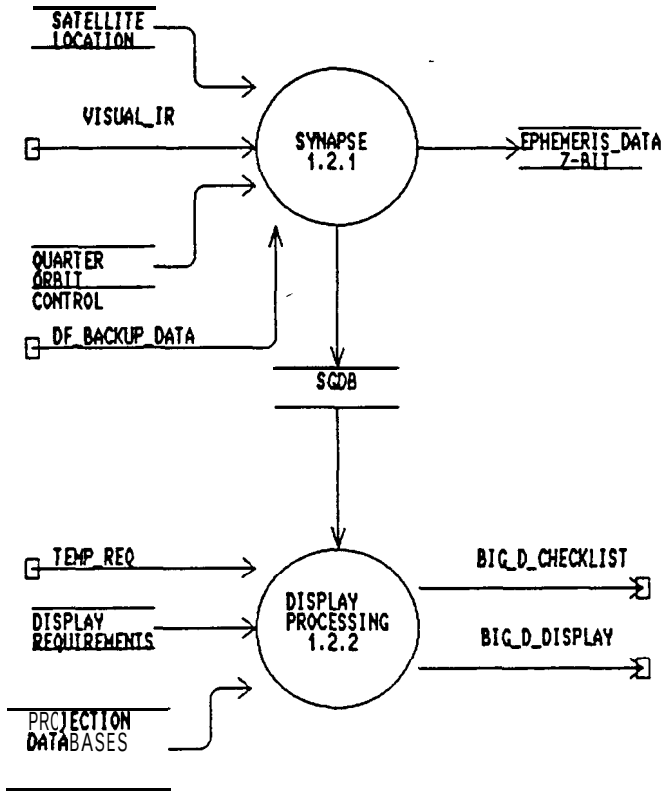
Project : C:\ECPLUS30\GWC2\
Chart : gwc1121
Filename : gwc_1121.dfd
Last modified on : May-25-1993
by User : MONTE

LOCATION PROCESSING
1.1.2



roject : C:\ECPLUS30\GWCU0\
Chart : GWC_121
Filename : GWC_121.dfd
ast modified on : Sep-16-1992
by User : monte

PRIMARY SENSOR PROCESSING
1.2



NOTE: NO SOURCE FOR TEMP_RE
THIS IS A GENERAL CUSTOMER
REQUEST FROM ANY ONE THAT
WANTS A DISPLAY.

```
roject : C:\ECPLUS30\GWCU0\
hart : GWC1211
Filename : GWC_1211.dfd
Last modified on : Oct-12-1992
by User : monte
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SYNAPSE PROCESSING
1.2.1

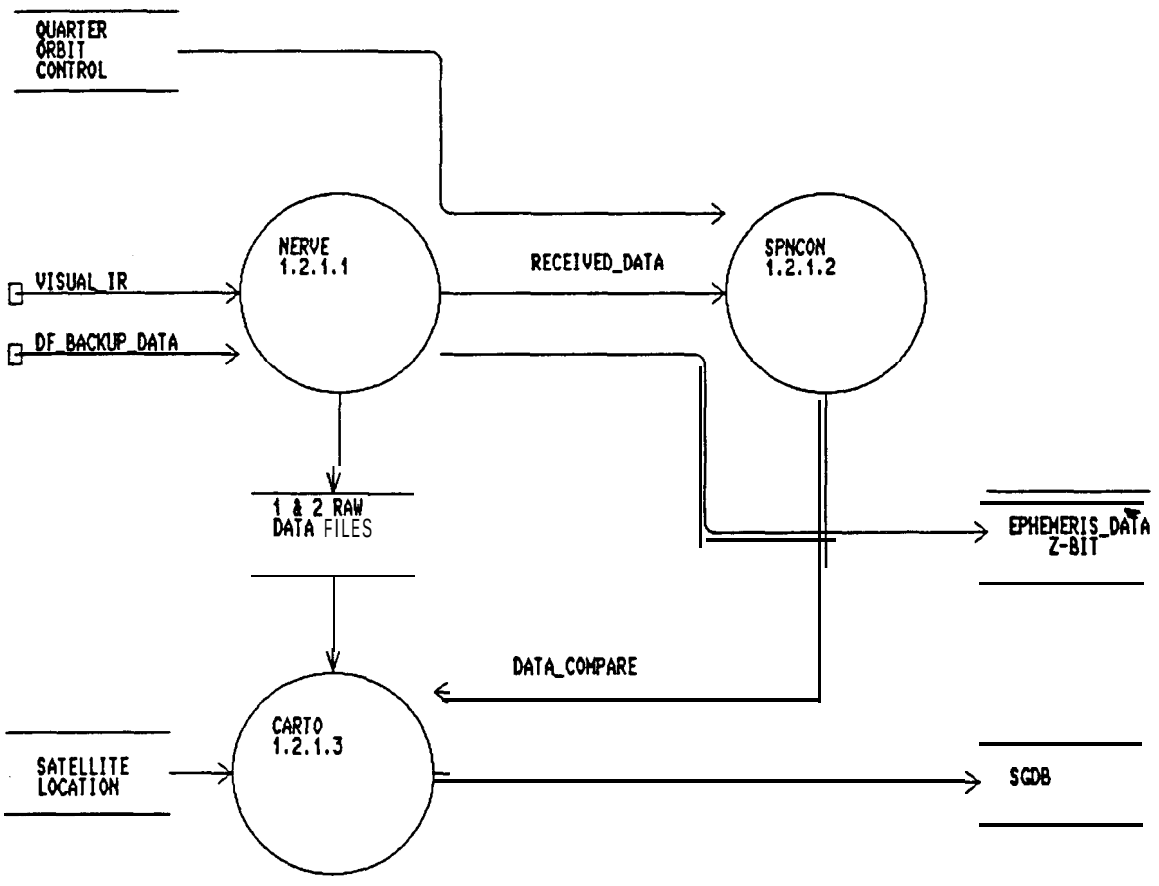

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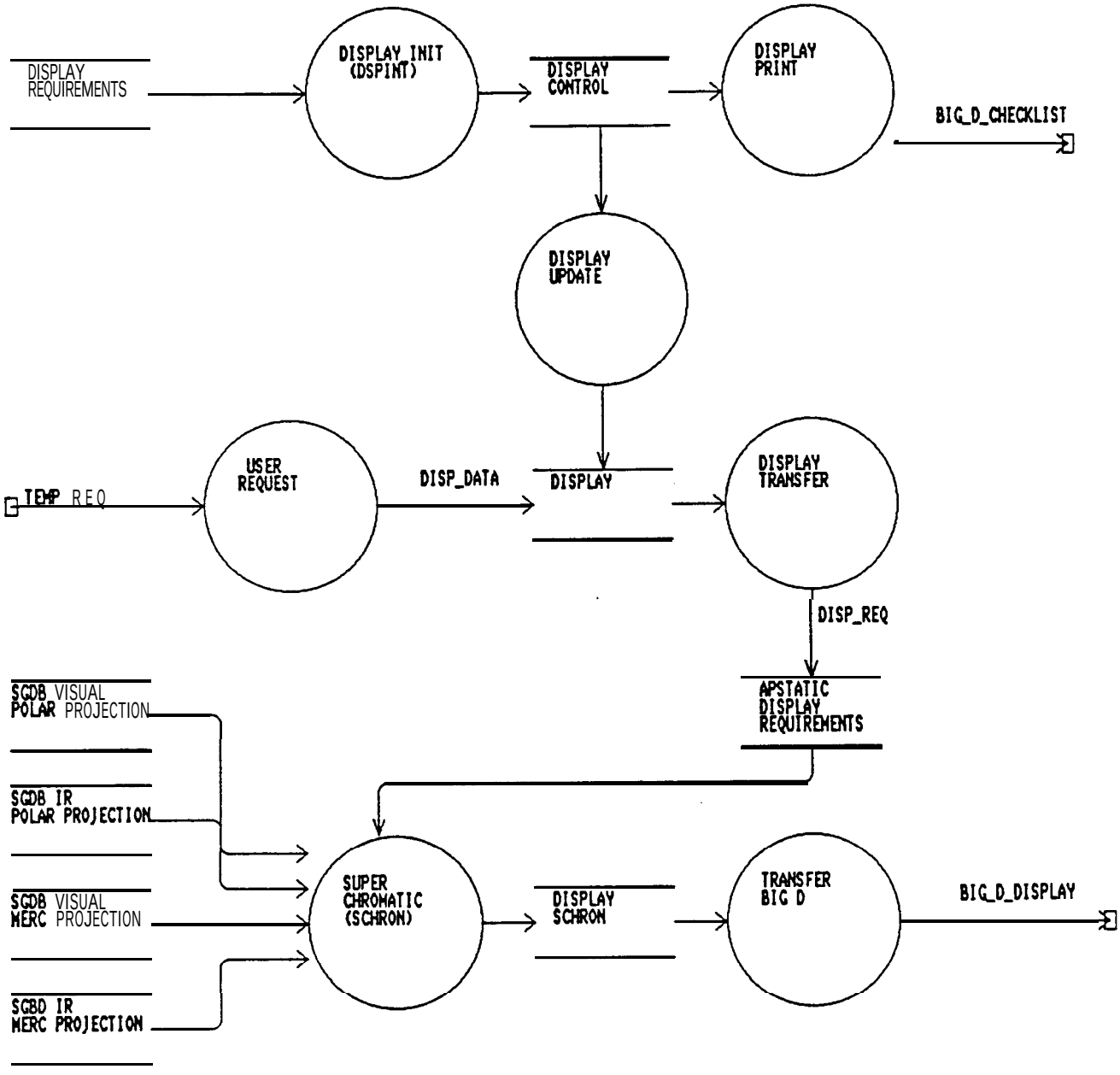
Chart : GWC1212
Filename : GWC_1212.dfd
Last modified on : Jun-29-1992
by User : monte

PRIMARY DATA DISPLAY PROCESSING
1.2.2



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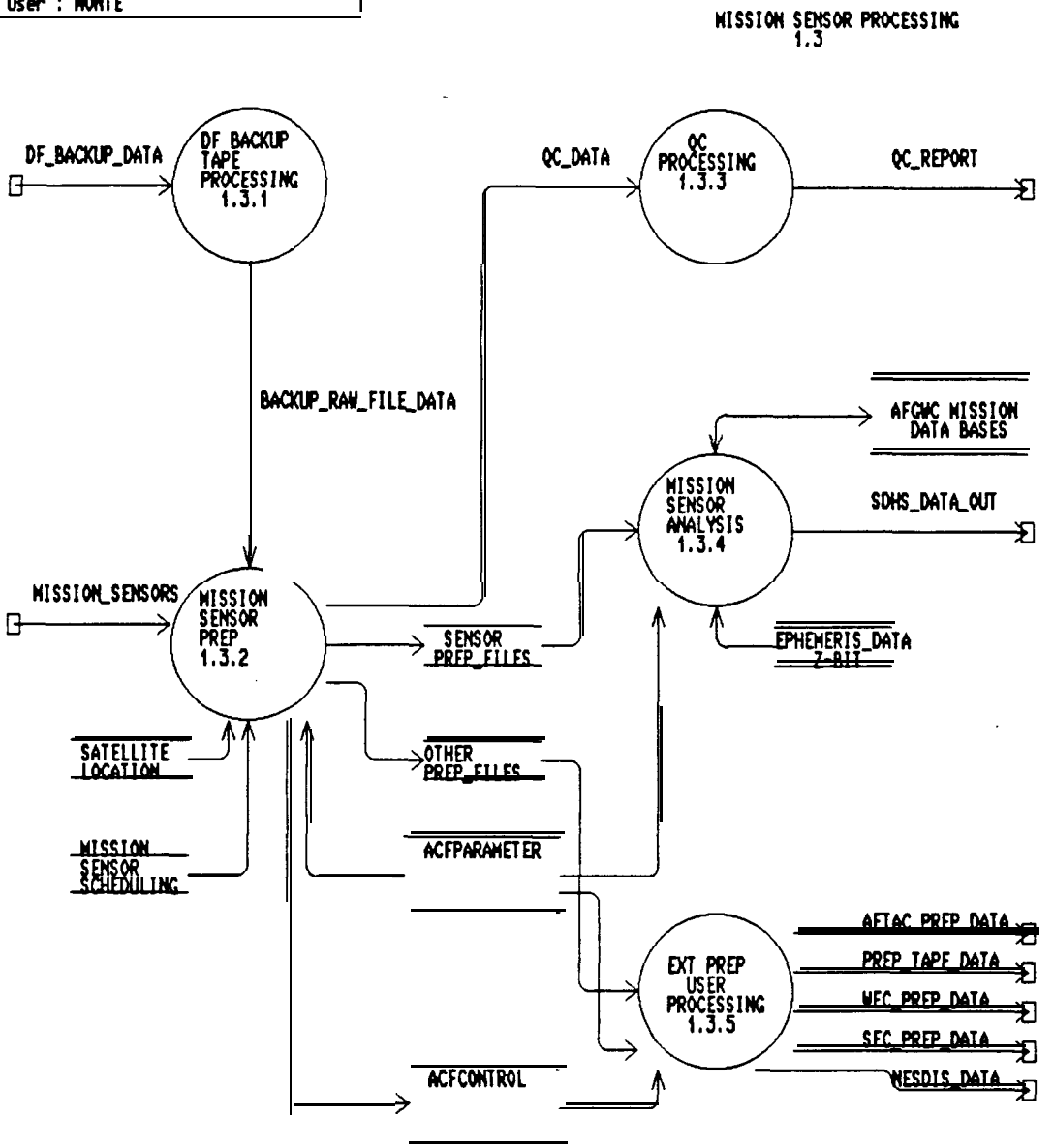
by User : MONTE



Project : C:\ECPLUS30\GWC2\
Chart : GWC1311
Filename : GWC_1311.dfd
Last modified on : May-25-1993
by User : MONTE

DF BACKUP TAPE PROCESSING
1.3.1

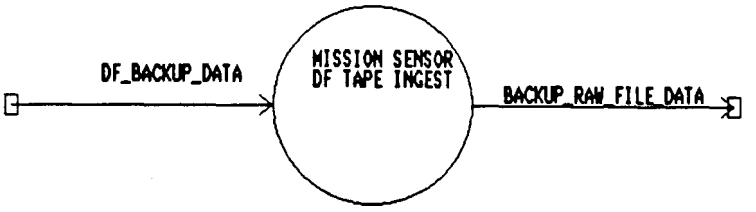


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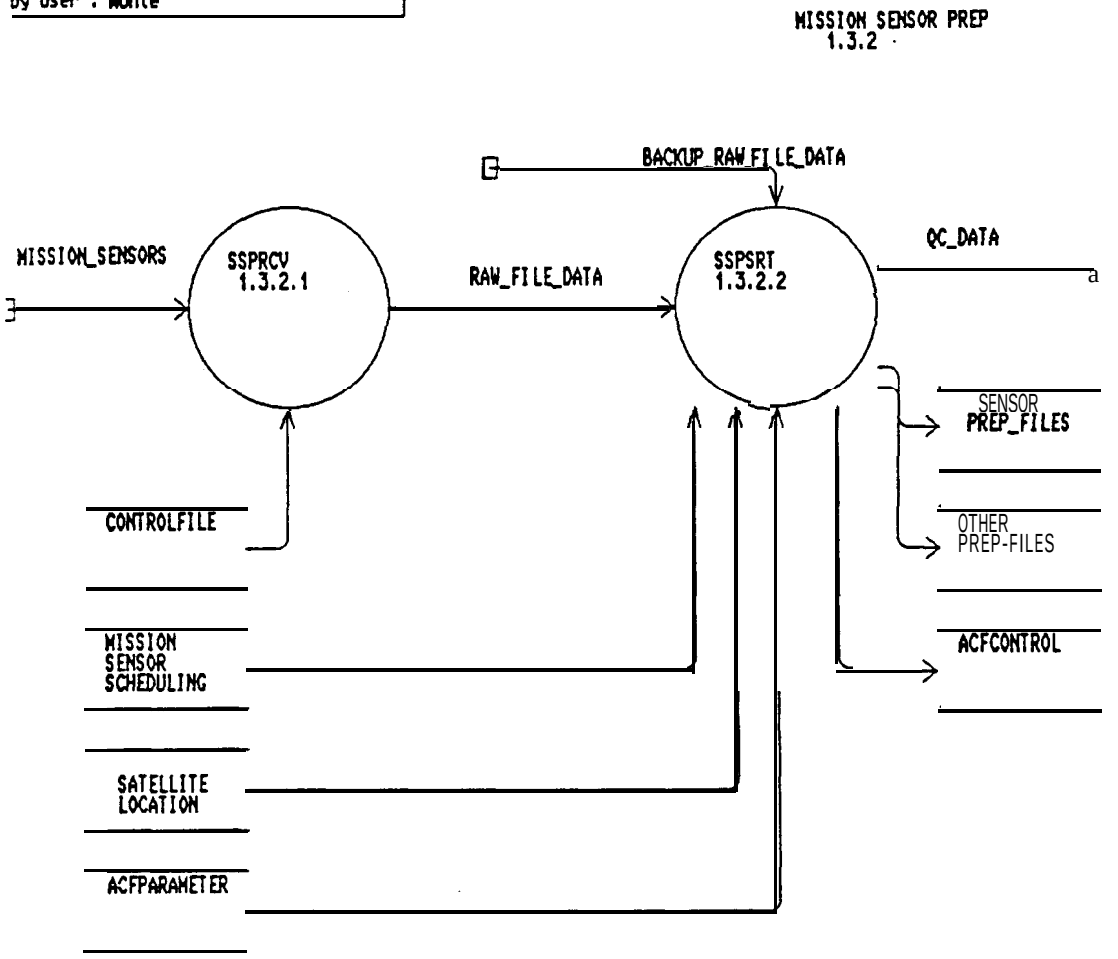
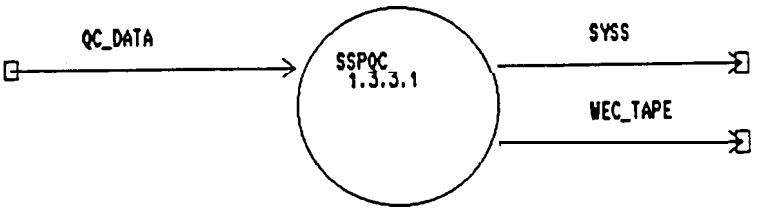
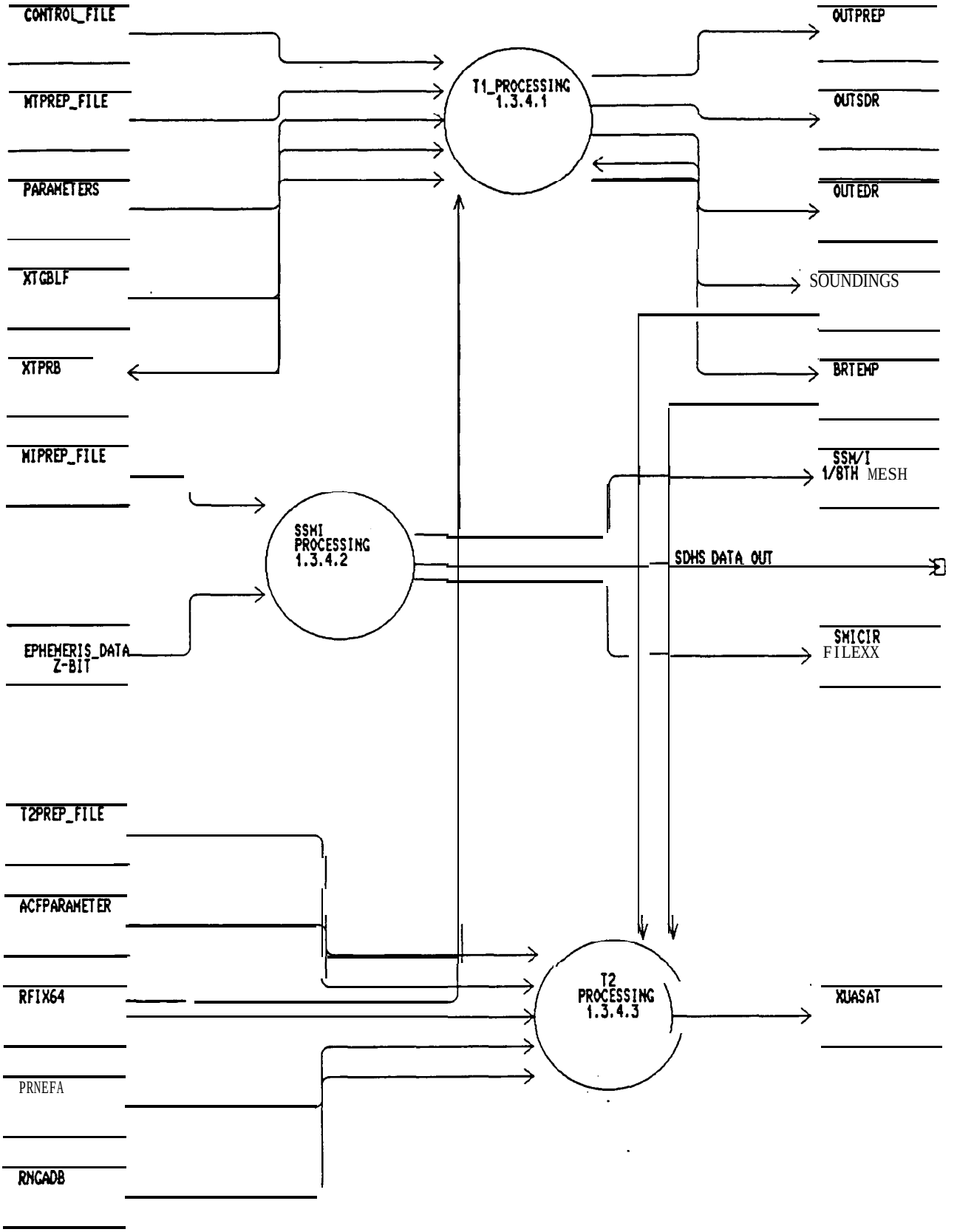
Chart : GWC1321
Filename : GWC1321.dfd
ast modified on :Sep-18-1992
by User : monte



QUALITY CONTROL PROCESSING
1.3.3



MISSION SENSOR ANALYSIS
1.3.4



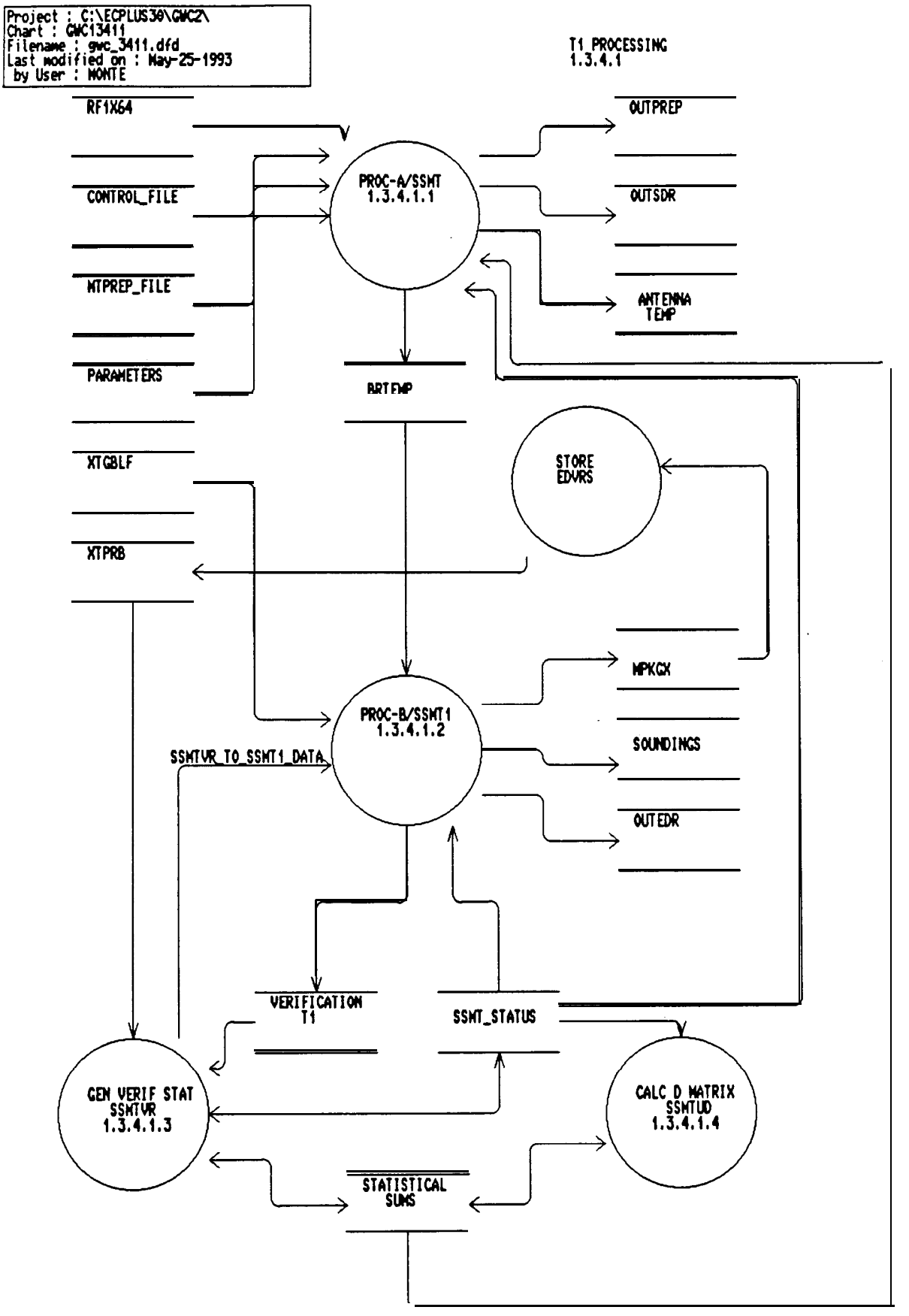

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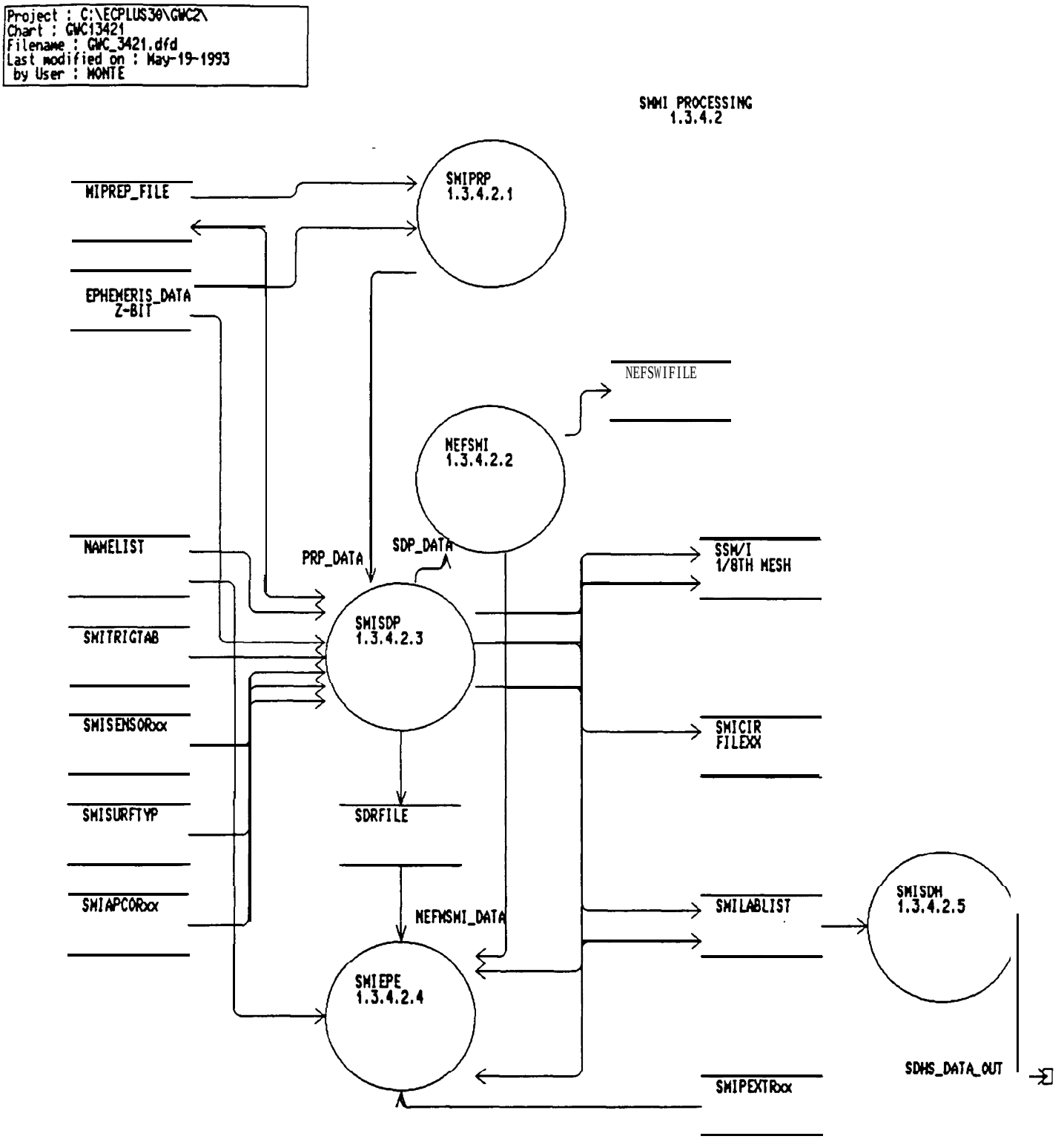
Chart : GWC13411
Filename : gwc_3411.dfd
Last modified on : May-25-1993
by User : MONTE
T1 PROCESSING
1.3.4.1
RF1X64
CONTROL_FILE
MTPREP_FILE
PARAMETERS
XTGBLF
XTPRB
PROC-A/SSMT
1.3.4.1.1
OUTPREP
OUTSDR
ANTENNA
TEMP
ARTEMP
STORE
EDVRS
MPKGX
PROC-B/SSMT1
1.3.4.1.2
SSMTVR_TO_SSMT1_DATA
SOUNDINGS
OUTEDR
VERIFICATION
T1
SSMT_STATUS
GEN VERIF STAT
SSMTVR
1.3.4.1.3
CALC D MATRIX
SSMTUD
1.3.4.1.4
STATISTICAL
SUMS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Last modified on : May-19-1993
by User : MONTE
SMMI PROCESSING
1.3.4.2
MIPREP_FILE
SMIPRP
1.3.4.2.1
EPHEMERIS_DATA
Z-BIT
NEFSWIFILE
NEFSMI
1.3.4.2.2
NAMELIST
PRP_DATA
SDP_DATA
SSM/I
1/8TH MESH
SMITRIGTAB
SMISDP
1.3.4.2.3
SMISENSORxx
SMICIR
FILEXX
SMISURFTYP
SDRFILE
SMIAPCORxx
NEFWSMI_DATA
SMILABLIST
SMISDH
1.3.4.2.5
SMIEPE
1.3.4.2.4
SDHS_DATA_OUT
SMIPEXTRxx

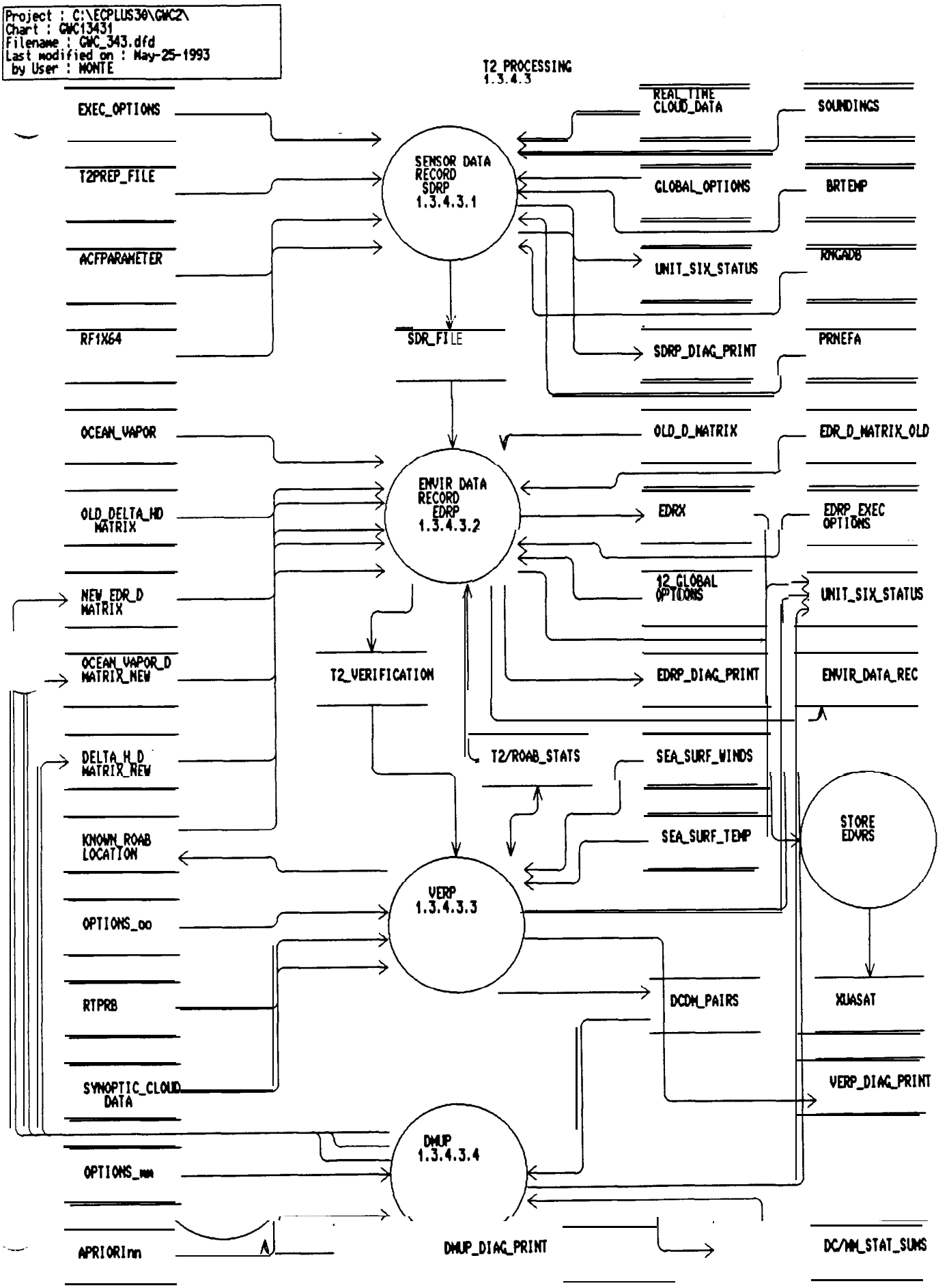
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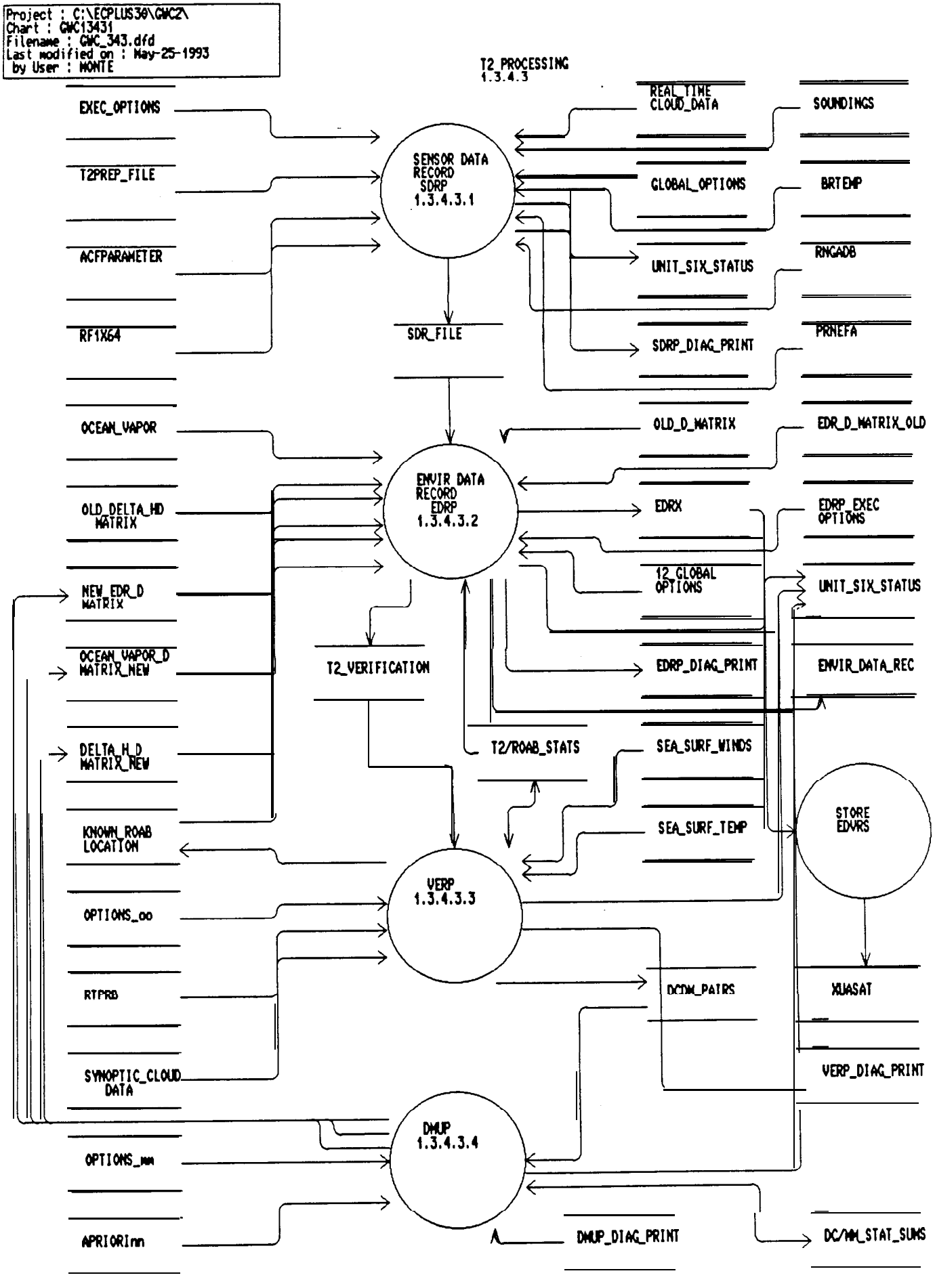
Chart : GWC13431
Filename : GWC_343.dfd
Last modified on : May-25-1993
by User : MONTE
T2_PROCESSING
1.3.4.3
EXEC_OPTIONS
T2PREP_FILE
ACFPARAMETER
RF1X64
OCEAN_VAPOR
OLD_DELTA_HD MATRIX
NEW_EDR_D MATRIX
OCEAN_VAPOR_D MATRIX_NEW
DELTA_H_D MATRIX_NEW
KNOWN_ROAB LOCATION
OPTIONS_oo
RTPRB
SYNOPTIC_CLOUD DATA
OPTIONS_mm
APRIORInn
SENSOR DATA RECORD SDRP 1.3.4.3.1
SDR_FILE
ENVIR DATA RECORD EDRP 1.3.4.3.2
T2_VERIFICATION
T2/ROAB_STATS
VERP 1.3.4.3.3
DMUP 1.3.4.3.4
DMUP_DIAG_PRINT
REAL_TIME CLOUD_DATA
GLOBAL_OPTIONS
UNIT_SIX_STATUS
SDRP_DIAG_PRINT
OLD_D_MATRIX
EDRX
T2_GLOBAL OPTIONS
EDRP_DIAG_PRINT
SEA_SURF_WINDS
SEA_SURF_TEMP
DCDM_PAIRS
SOUNDINGS
BRTEMP
RNGADB
PRNEFA
EDR_D_MATRIX_OLD
EDRP_EXEC OPTIONS
UNIT_SIX_STATUS
ENVIR_DATA_REC
STORE EDVRS
XUASAT
VERP_DIAG_PRINT
DC/MM_STAT_SUMS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by User : MONTE
T2 PROCESSING
1.3.4.3
EXEC_OPTIONS
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ACFPARAMETER
RF1X64
OCEAN_VAPOR
OLD_DELTA_HD MATRIX
NEW_EDR_D MATRIX
OCEAN_VAPOR_D MATRIX_NEW
DELTA_H_D MATRIX_NEW
KNOWN_ROAB LOCATION
OPTIONS_oo
RTPRB
SYNOPTIC_CLOUD DATA
OPTIONS_mm
APRIORInn
SENSOR DATA RECORD SDRP 1.3.4.3.1
ENVIR DATA RECORD EDRP 1.3.4.3.2
VERP 1.3.4.3.3
DMUP 1.3.4.3.4
SDR_FILE
T2_VERIFICATION
T2/ROAB_STATS
REAL_TIME CLOUD_DATA
GLOBAL_OPTIONS
UNIT_SIX_STATUS
SDRP_DIAG_PRINT
SOUNDINGS
BRTEMP
RNGADB
PRNEFA
OLD_D_MATRIX
EDR_D_MATRIX_OLD
EDRX
EDRP_EXEC OPTIONS
T2_GLOBAL OPTIONS
UNIT_SIX_STATUS
EDRP_DIAG_PRINT
ENVIR_DATA_REC
SEA_SURF_WINDS
SEA_SURF_TEMP
STORE EDVRS
DCDM_PAIRS
XUASAT
VERP_DIAG_PRINT
DMUP_DIAG_PRINT
DC/MM_STAT_SUMS

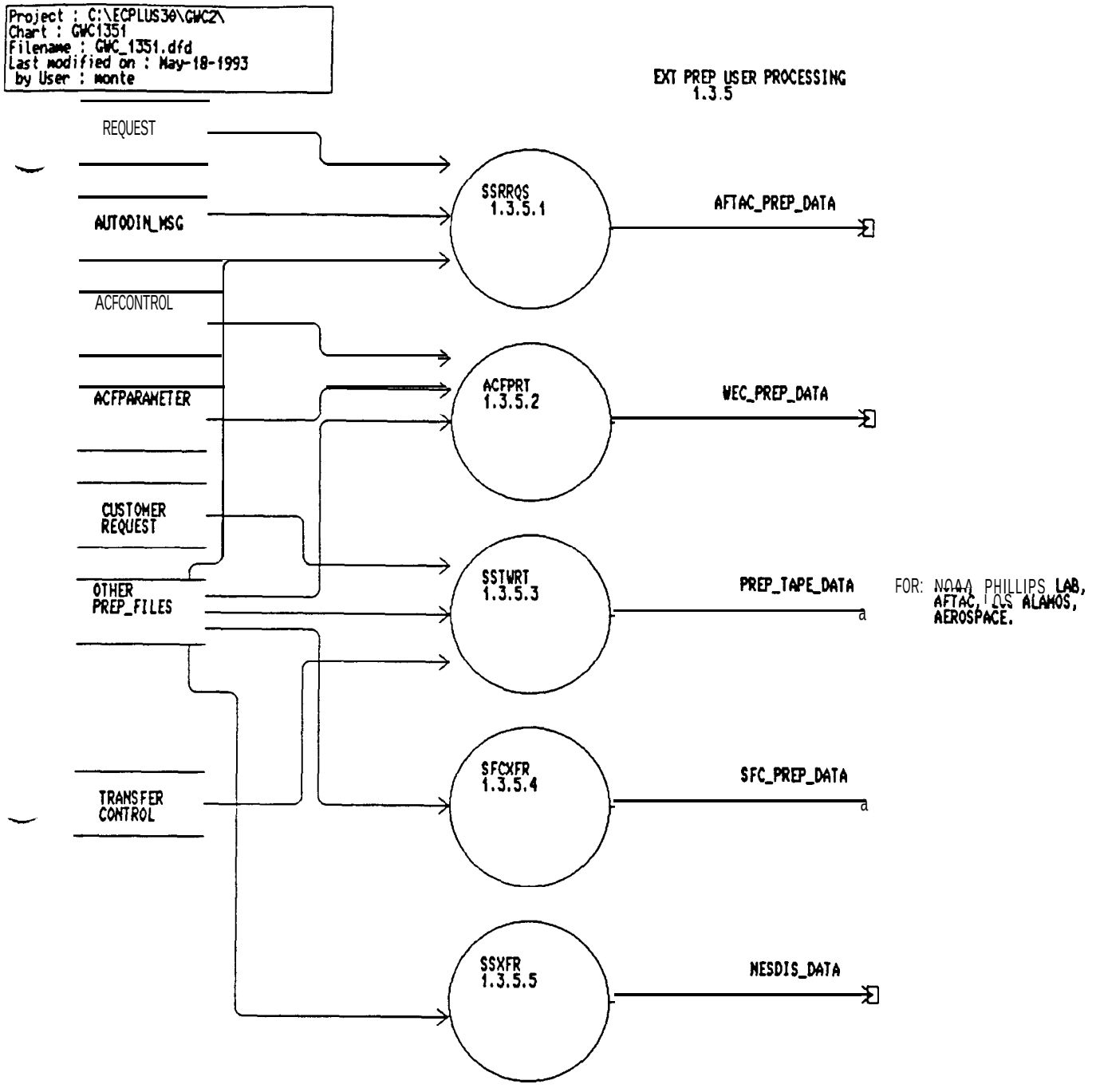
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Chart : GWC1351
Filename : GWC_1351.dfd
Last modified on : May-18-1993
by User : monte
EXT PREP USER PROCESSING
1.3.5
REQUEST
AUTODIN_MSG
ACFCONTROL
ACFPARAMETER
CUSTOMER REQUEST
OTHER PREP_FILES
TRANSFER CONTROL
SSRRQS
1.3.5.1
ACFPRT
1.3.5.2
SSTWRT
1.3.5.3
SFCXFR
1.3.5.4
SSXFR
1.3.5.5
AFTAC_PREP_DATA
WEC_PREP_DATA
PREP_TAPE_DATA
SFC_PREP_DATA
NESDIS_DATA
FOR: NOAA, PHILLIPS LAB, AFTAC, LOS ALAMOS, AEROSPACE.

APPENDIX B

MISSION SENSORS

SENSOR	FUNCTION
SSB/X2	A scanning gamma-ray and x-ray sensor used for locating and characterizing x-ray sources in the atmosphere
SSB/S	A scanning x-ray intensity sensor used to locate x-ray sources in the atmosphere and measure their energy spectrum
SS/IES	Ionospheric Scintillation Plasma Monitor; two electrostatic probes are used (electron and ion) to gather data required for Air Force HF and UHF communication systems
SSK	A Classified Sensor
SSIE	Ionospheric Plasma Monitor system to characterize space plasma above the peak of the ionospheric F region
SSJ/4	Precipitating Electron/Proton Spectrometer; used to detect and analyze the electrons precipitating into the atmosphere which produce the aurora1 display
SSJ*	Radiation Dosimeter; measures the accumulated radiation dose produced by electrons, protons, and nuclear interactions produced by energetic protons
SSM	A triaxial magnetometer for precision measurement of the earth's magnetic field
SSM/I	A multi-channel, dual polarized, conically scanning microwave imager. It measures ocean surface wind speed, precipitation location and intensity, cloud water content, land surface moisture, and ocean ice coverage and age.
SSMIS	Combination of SSM/I and SSM/T
SSM/T-f	Microwave Temperature Sounder (SSM/T-1); A seven channel microwave radiometer that senses in the 50 to 60 GHz band. This instrument measures microwave radiation emitted from different heights

within the atmosphere. This data allows forecasters to calculate profiles of temperature versus altitude regardless of cloud cover. A companion sensor, the Microwave Water Vapor Sounder (SSM/T-2), measures humidity in the atmosphere.

SSM/T-2 Microwave Moisture Sounder (SSM/T-2); A five channel microwave radiometer that senses with three channels near 183 GHz (water vapor resonance line) and two window channels at 91.6 GHz and 150 GHz. This data along with data from the SSM/T-1 sensor allows water vapor (relative and specific humidity) profiles to be calculated at selected pressure levels between 1000 mb and 300 mb.